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ABSTRACT

Anxiety and tension are two affective factors which seem to interfere with measurement of instructional effects. Test anxiety respresents a possibly confounding effect in the measurement of any given knowledge. A study was conducted to examine the effect that relaxation training administered immediately prior to testing would have on academic achievement and to discern the consequences of such a program in today's schools in their efforts to mitigate the detrimental effects of test anxiety. Predominantly black seventh and eighth graders (N=67) were assigned to one of four groups. Group 1 was pretested on the Cognitive Abilities Test (CAT) and received relaxation training; group 2 received relaxation training and took the CAT as a posttest; group 3 was pretested and untrained; and group 4 was untrained and posttested. The relaxation training consisted of guided imagery and deep breathing techniques. Although no effect was observed, data analysis revealed an optimum level of stress, below or above which test performance tended to suffer. The failure to observe a relationship between relaxation training and test performance seemed to originate when some students with initial low stress were relaxed beyond the optimum level so that their performance suffered, while other students with high initial stress moved toward an optimum level and improved their performance. Comparisons between relaxed experimental students and their controls revealed that experimental students outperformed control students on some subsets of the Cognitive Abilities Test. (NB)

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THE EFFECT OF RELAXATION TRAINING ON TEST BEHAVIOR IN A THINKING SKILLS PROGRAM

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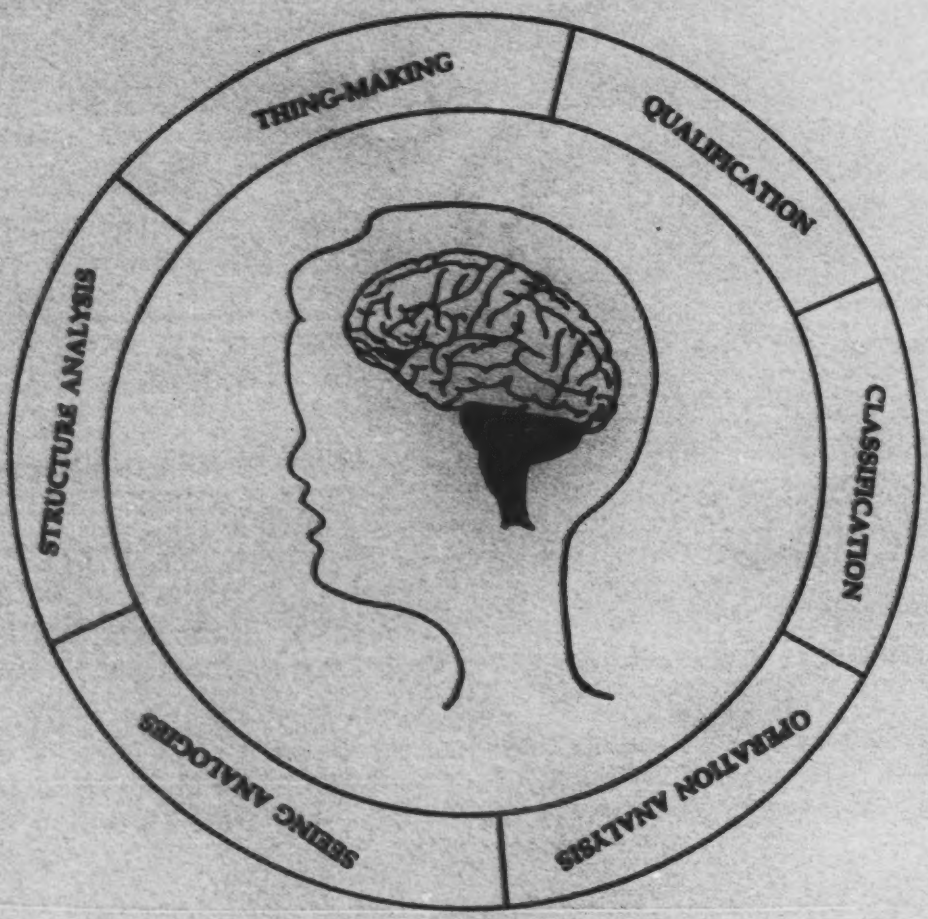

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THE EFFECT OF RELAXATION TRAINING ON TEST BEHAVIOR IN A THINKING SKILLS PROGRAM

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ABSTRACT

The researcher conducted this study to test the effect of relaxation exercises on test performance following instruction in cognitive thinking skills in middle school. Although no effect was observed, data analysis revealed an optimum level of stress, below or above which test performance tends to suffer. The failure to observe a relationship between relaxation training and test performance seemed to originate when some students with initial low stress were relaxed beyond the optimum level so that their performance suffered, while other students with high initial stress moved toward an optimum level and improved their performance.

Pretest to posttest scores on a summative cognitive abilities test showed that students' performance improved following instruction in critical thinking skills. Comparisons between relaxed experimental students and their controls revealed that experimental students outperformed control students on some subtests of the Cognitive Abilities Test.

INTRODUCTION

Affective components influence cognitive performance measures. Anxiety and tension are two affective factors which seem to interfere with measurement of instructional effects. The variable of test anxiety represents a possibly confounding effect in the measurement of any given knowledge. Test anxiety is a variable and its effects need to be diminished in order to assess a student's true achievement. On the other hand, test anxiety seems to be "part of the territory" in these days of concern regarding basic skills and scores on minimum competency tests; therefore, a strategy which diminishes feelings of anxiety in a group of students allows the teacher to assess the "real" knowledge of students. Many features of regular psychometric practice relate to students' being "test anxious." These features include the difficulty of tests, frequency of testing, time limits of test administration, reports of test scores to parents and students, and the impact of tests on the students' evaluations. The researcher conducted this study to examine the effect that relaxation training administered immediately prior to testing would have on academic achievement and to discern the consequences of such a program in today's schools in their efforts to mitigate the detrimental effects of test anxiety.

Relaxation training is the administration of a group of techniques in an attempt to reduce anxiety and tension and, thus, to promote clarity of thinking. The effect of

relaxation training on various cognitive outcomes is one which has been documented in research (Matthews, 1984, 1986). Although relaxation training includes a variety of techniques, the training in this study specifically incorporates the techniques of guided imagery and deep breathing because these techniques are simple to use and appeal to children.

Measurement of changes in peripheral temperature allows examination of the level of anxiety and tension of individual students. Research indicates that as humans relax and anxiety diminishes, there are physiological changes which cause a person's wrists and fingers to become warmer (Matthews & Quinn, 1986). Test anxiety is a variable which differentially affects test performance; therefore, a physiological measure of tension and anxiety may be considered more objective and reliable than the paper-and-pencil self-report type of instruments which typify this area of research.

In the present study, the content domain which defines the area for testing of academic achievement is high order thinking skills and problem solving. Although higher order thinking skills seem forgotten in the rush of the public education movement of "back to the basics," there is a reemergence today of a concern for students to be able to analyze, synthesize, and evaluate. There appears to be an increasing popularity of programs which purport to teach these skills. Thinking skills curricular packages may be

domain-specific (i.e., definitely tied to a particular subject matter, such as language arts or mathematics); but nondomain-specific programs attempt to teach generic strategies in the context of any school subject or life situation. Because the subject matter of these generic programs is nonspecific, such programs are readily adaptable to incorporation into an established curriculum; thus, the instructional program in this study utilizes a nondomain-specific package as the primary content base. There appears to be a link between these nondomain-specific programs and academic achievement in traditional subjects (DeBono, 1982; Sternberg, 1986). Additionally, these programs seem to influence scores on aptitude measures which are constructed to be relatively impervious to instructional intervention.

Related Literature

The effects of anxiety on classroom performance and achievement are a major concern of educators and researchers. One study (Stevenson & Odom, 1965) revealed a significant negative correlation between test anxiety and test performance. Sarason (1966) noted that "low-anxious" students had higher achievement test performance than "high-anxious" students when I.Q. was held constant. Other research showed that highly anxious students had lower reading scores, slower reading rates, and reduced comprehension in comparison to less anxious students (Gifford & Marston, 1966; Colter & Palmer, 1970). A study

of fourth grade students in both formal and informal classroom settings showed that achievement of students experiencing low anxiety was better in both classroom settings than that of students who were highly anxious (O'Tuel & Terry, 1979). Individuals who were highly anxious exhibited low competence in test performance in the areas involving paired associates (Stevenson & Odom, 1965) and anagram learning (Goldlang, 1982; Stevenson & Odom, 1965). Sieber (1969) reported that test anxiety interfered with short-term memory. Also, Zatz and Chassin (1985) noted that test-anxious elementary children displayed task-debilitating cognitions while being tested.

Worry and arousal are two dimensions of test anxiety. Wine (1970/1971) concluded that worry interfered directly with performance and affects physiological arousal. Worry is a cognitive concern about one's performance, whereas arousal (emotionality) is a self-perceived physiological state in which autonomic reactions tend to occur under examination.

Eaton (1980) stated that defensiveness, a stable personality trait, had causal effects on anxiety, especially for boys (Eaton, 1979). According to Eaton (1978), situational factors affected anxiety, but defensiveness was a function of organismic factors. Holmes (1972) reported that anxiety and defensiveness related inversely to reading achievement. Robinson (1983) discussed a level of anxiety

which was considered a productive level rather than a harmful one and suggested that performance on examinations taken by students whose test anxiety levels were within this productive realm would be better than the performance of highly anxious students.

Various test conditions affect anxiety. Forhetz (1969) reported that ordering of tests by difficulty changed students' anxiety levels. Hill (1975) stated that extremely anxious students performed poorly on basic mathematical skills when conditions involved time pressure and failure, but these students did better when performance was not timed and fear of failure was reduced. French and Greer (1964) suggested that arrangement of test items was not a critical factor in the behavior of similar groups of first grade children who were responding to similar tasks; however, test item arrangement could have been a factor for some persons within the groups. Goldlang (1982) stated that highly anxious students who were given control over choosing between tests which contained items of easy, medium, or difficult status tended to choose tests of medium difficulty.

Some studies showed that test anxiety depressed learning of learning-disabled children in the areas of reading (Kirk, 1981; Bryan, Sonnefeld & Grabowski, 1983) and mathematics (Bryan, Sonnefeld & Grabowski, 1983). Rubenzer (1984) noted a negative effect of anxiety on intellectual performance for gifted students. Little research exists pertaining to

the relationship of test anxiety on achievement of a group of students having heterogenous ability, as is the case in an average classroom.

Some researchers organized subjects by race (Houck, 1983; Solkoff, 1971), sex (Houck, 1983; Rodgers, 1979/1980; Wade, 1981), or socio-economic status (Dunn & Shanks, 1967) to study the possible confounding effects of these variables on test performance or anxiety. Dunn and Shanks (1967) reported that children from low socio-economic classes manifested a higher degree of test anxiety than children from the upper socio-economic classes, especially in elementary school. Other research showed no significant effect of sex or race on test performance (Houck, 1983). Wade (1981), however, reported higher correlations between anxiety, motivation, and ability for girls than the equivalent correlations for boys. Rodgers (1979/1980) stated that female students scored higher on the Sarason Test Anxiety Scale than did males. Solkoff (1971) reported that black children generally scored lower than white students on a test anxiety questionnaire.

Research reflected the use of a variety of techniques to reduce test anxiety. Relaxation-desensitization exercises (Robinson, 1983), self-coping cognitive techniques (Crowley, 1982), self-correction psychotherapy (Kirk, 1981), reduction of the formality of the task and deemphasis of its importance (Hill, 1980), strategy training (Walters & Tobias, 1985), and guided imagery (Anderson, 1980; Deffenbucher & Kemper,

1974) were methods which had been reported as being successful in reducing test anxiety, thus increasing performance. Ayers (1981) used cognitive modification counseling successfully to reduce test anxiety but reported no significant increase in performance as a result of lowering anxiety. Another study reported no increase in academic achievement resulting from the use of relaxation training, in particular, progressive relaxation (Spillios & Janzen, 1983).

The majority of the research that appeared in the literature employed an intervention program over a period of time to reduce test anxiety in persons identified as test anxious. Studies showing the effects of an intervention procedure immediately before test administration with the normal population seemed nonexistent. Although one may anticipate that relaxation training transfers to the test setting, that expectation remains suspect without empirical evidence.

Specifically, this study addressed the following research inquiries: How can relaxation training influence test performance? How do physiological measures of anxiety and tension respond to relaxation training? How are physiological measures of anxiety and tension related to test performance? What effect does a thinking skills curriculum have on children's scores on a cognitive abilities test?

Hypotheses

The researcher tested the following hypotheses:

1. Students who undergo relaxation training will tend to exhibit higher peripheral temperatures following the training each week than they did just prior to each relaxation training session.

2. Students who take the Cognitive Abilities Test after an instructional course in critical thinking skills will tend to score higher than similar students who take the test prior to the instruction.

3. Students who receive relaxation training will tend to score higher on the Cognitive Abilities Test on postassessment than similar students who receive no relaxation training.

4. Students who receive relaxation training immediately before testing will tend to score higher on a series of achievement tests than a similar group of students who receive no relaxation training.

5. Achievement test scores will be positively related to the degree of relaxation as measured by peripheral temperature.

Variables

In this section the researcher identifies the variables for each hypothesis of the study. Further description of the time and circumstances of their observation appears subsequent to this part.

In Hypothesis 1, the independent variable was the time of wrist temperature measurement, before a relaxation exercise began (prerelaxation) and after a relaxation exercise ended (postrelaxation). The dependent variable was peripheral temperature observed at the wrist via a Bio-Temp wrist band which used liquid crystal technology to measure temperature. The researcher conceived this variable to be a measure of the degree to which a student was relaxed, free of anxiety or tension.

The purpose of Hypothesis 2 was to measure the effect of instruction in critical thinking skills as scores on the Cognitive Abilities Test, an instrument with nine subtests. The researcher operationalized the dependent variable as scores on eight of the nine subtests: (1) verbal classification (vocabulary), (2) sentence completion, (3) verbal analogies, (4) figure classification, (5) figure analogies, (6) figure analysis, (7) quantitative relations, and (8) number series. In effect, the researcher might have regarded the hypothesis as eight hypotheses. For each hypothesis, the researcher operationalized the independent variable as two groups of students, one which marked the test prior to instruction in thinking skills (pretest group) and one which marked the test subsequent to instruction (posttest group). These groups consisted of approximately equal numbers of students in each of the two levels of the independent variable in Hypothesis 4 (trained and untrained students).

In Hypothesis 3, there was an expressed comparison between the performance of the trained students and the performance of the untrained students in the posttest group on the Cognitive Abilities Test. The test scores constituted the dependent variable. The independent variable consisted of (1) the half of the posttest students who received relaxation training and (2) the half of the posttest students who received no relaxation training.

The researcher used the same independent variable in Hypothesis 4 as in Hypothesis 3, the trained versus untrained groups. Operationalization of the dependent variable was via student scores on six researcher-made timed achievement tests, the field-testing of which is described subsequently. The researcher used the six test scores, one for each week of the study, as repeated measures in a repeated-measure analysis of variance, testing for a group (trained v. untrained) effect.

In Hypothesis 5, the observed wrist temperature was the independent variable. This variable was the dependent variable in Hypothesis 1, also. The dependent variable for Hypothesis 5 was the same as the dependent variable for Hypothesis 4, the sum of weekly test scores by student expressed as *z* scores.

METHOD

Sample

The 67 participants in the study comprised the seventh (34 students) and eighth (33 students) grades of Felton

Laboratory School at South Carolina State College, Orangeburg, South Carolina. The distribution of students was approximately equal in terms of sex (33 males and 34 females). Race was predominantly black (63 black, 2 white, and 2 Indian). Students' ability levels ranged from low to high; however, the majority of the students had average or above average ability because the school's population was drawn mainly from the children of faculty and staff of South Carolina State College. One child (male) transferred to another school after the study began; therefore, the sample was reduced by one toward the end of the instructional phase.

The researcher randomly assigned students to two groups, a relaxation group and a control (no relaxation) group. Each of these groups consisted of two randomly assigned subgroups, one to be pretested on the Cognitive Abilities Test before instruction in critical thinking skills and the other to be posttested using the same instrument after instruction. Thus, the sample consisted of four groups: (1) a pretested, trained group; (2) a posttested, trained group; (3) a pretested, untrained group; and (4) a posttested untrained group. The researcher chose this four-group design for two reasons: (1) to control for retest bias on the cognitive ability test for Hypothesis 2 and (2) to enable the comparisons between trained and untrained students for testing of Hypotheses 3 and 4.

Procedure

Prior to the commencement of instruction, one half of the students in both the trained and untrained groups marked the Cognitive Abilities Test to provide preinstruction test scores. The remaining students marked the Cognitive Abilities Test only after the end of all instruction, thus providing postinstruction measures.

Students met for instruction in critical thinking skills on Monday, Tuesday, and Wednesday mornings during the weeks of October 6 through November 12, 1986. This instruction took place during two sessions each day in the time slots that normally comprised the language arts block for each student. During each session, one seventh and one eighth grade class met together. Instruction on each Monday and Tuesday consisted of a 60-minute teaching program. Wednesday's instructional period lasted only 20 minutes to allow time for recording peripheral temperatures, instructing the experimental group in relaxation exercises, administering the achievement test which pertained to that particular week's study, and supervising the "free selection" reading activities for the control group.

On Wednesday, students placed a temperature indicator on their wrists prior to instruction in critical thinking skills. The reason for placing the indicator on the wrists before instruction was to allow time (Matthews & Quinn, 1986) for the students' peripheral temperatures to adjust to room (ambient) temperature before taking temperature

readings. All children recorded their temperature readings after instruction, as well as before and after testing.

To control for teacher bias, the instructor left the room prior to the separation of students into control and experimental groups and had no involvement in the relaxation training or testing procedure. After the teacher exited, pupils divided according to their membership in either the experimental or control group. A research assistant took the control group (half of the students from each grade) to another classroom and immediately administered the 15-minute test of academic achievement to that group. Upon completion of the test, students in the control group engaged in 10 minutes of "free selection" reading activities which afforded the students the opportunity to read at leisure or to work crossword puzzles and anagrams. While the control group (untrained) was being tested, the researcher instructed the experimental group (trained) in relaxation exercises for 10 minutes. After relaxation training, the experimental group received testing.

To insure that students were placed under stress, the researcher incorporated certain stressful elements into the testing situation. Each test contained more test items than even the fastest student could complete in the allotted time. Item difficulty contributed to the inducement of stress in that some items were too difficult for students to answer without more extensive training than the instruction

given in the present study. In addition, students' scores on these tests served as a part of their language arts grades. Also, the researcher emphasized the importance of competition with one's previous performance. Every week, each student, as well as parents and school administrators, received a report of achievement (ranking with other students) on that particular week's test. Ranking of scores was from the highest to lowest score, and the score of the student receiving the report was circled.

Because peripheral temperature was a possible indicator of the degree of relaxation induced by the experimental component of relaxation training (Matthews, 1982; 1984; 1986), students recorded peripheral temperature readings several times on Wednesday. All students reported peripheral temperature measures before and after each Wednesday's instruction in critical thinking skills and again before and after each testing session. In addition, all experimental subjects reported their peripheral temperature measurements immediately prior to and following the relaxation training. Because evidence existed that peripheral temperature was not only reflective of a person's internal psychological state but also was a function of environmental factors (i.e., ambient temperature of the room and the circadian thermal cycle), the researcher adjusted the peripheral temperature readings as suggested by Matthews and Quinn (1986).

Instruction

Relaxation Training

Relaxation training consisted of relaxation exercises of approximately 10-minutes duration on audio-cassette tapes. The exercises, developed by the researcher specifically for use with young people, incorporated the techniques of guided imagery and deep breathing. Guided imagery is a technique which integrates cognitive with experiential learning and involves focusing, passivity, and receptivity. The technique enhances the development of the imagination. Guided imagery utilizes both the mind and the emotions as tools for exploring and objectively understanding oneself. The titles of the six tapes used in this study were: (1) "Test Anxiety," (2) "Island Tour," (3) "A Hike to a Waterfall," (4) "A Visit to the Zoo," (5) "Swamp Trip," and (6) "Animal Friends." An example of one of the relaxation exercises before production onto cassette tape comprises Appendix A.

Critical Thinking Skills

The content of classroom instruction was critical thinking skills as described by the nondomain-specific curricular package, Strategic Reasoning (Glade & Rossa, 1985), which is published by Innovative Sciences, Inc. The skills included in this program were thing-making, qualification, classification, operation analysis, seeing analogies, and structure analysis. Thing-making, or vocabulary building, is the mental process of becoming aware of a "thing" and

naming it. Qualification denotes the skill used in recognizing unique attributes (sensory, logical, or emotional) of an object or person; whereas, classification is the sorting of things into groups according to common qualities. Operation analysis involves the thought sequencing that is necessary to be able to recognize the relationship between an event, operation, or transformation and the stages and substages that constitute it. Seeing analogies is the series of mental operations required to recognize the similarity between relationships. Structure analysis, the highest skill, is the process of acquiring an awareness of the relationship between a whole structure and its parts.

Students received instruction in one skill per week. During instruction, the teacher encouraged students to think and to verbalize their ideas, especially if they perceived a problem in a manner different from that which had been discussed. Handouts supplemented the oral instruction and prepared the students for testing because the items on the handouts were similar to the items on the tests. The instructor discussed each item on every handout, giving detailed explanations about why a particular response was or was not appropriate. The dates on which specific skills were taught and tested appear in Table 1.

Instrumentation

Monitoring Instruments

The Biotic-Band, manufactured by Bio-Temp Products, Inc., served as the measuring device for peripheral

Table 1

Curriculum Schedule

Week	Date	Activity	Test
1	October 6	Thing-Making	
	October 7	Thing-Making	
	October 8	Thing-Making	1
2	October 13	Qualification	
	October 14	Qualification	
	October 15	Qualification	2
3	October 20	Classification	
	October 21	Classification	
	October 22	Classification	3
4	October 27	Operation Analysis	
	October 28	Operation Analysis	
	October 29	Operation Analysis	4
5	November 3	Seeing Analogies	
	November 4	Seeing Analogies	
	November 5	Seeing Analogies	5
6	November 10	Structure Analysis	
	November 11	Structure Analysis	
	November 12	Structure Analysis	6

temperature. The wrist band contained liquid crystals and resembled an ordinary wrist watch. Each student placed the portion of the band containing the liquid crystals against the inside of the wrist on the dominant hand, thus allowing easy digital readout. A change in the digital readout, as well as a change in the color of the digits, reflected a change in peripheral temperature. The temperature range of the wrist band was 72° Fahrenheit to 100° Fahrenheit.

Cognitive Abilities Test

The Cognitive Abilities Test by R. L. Thorndike and Elizabeth Hagan is a standardized measure of mental aptitude. The researcher used levels E-G of the multilevel edition of the test in this study. The multilevel edition contains 8 overlapping levels for grades 3-12: A (3), B (4), C (5), D (6), E (7), F (8-9), G (10-11), and H (12) (Mitchell, 1985). The test consists of three batteries: verbal, quantitative, and nonverbal. The verbal battery is made up of three subtests: verbal classification, sentence completion, and verbal analogies. The quantitative battery consists of quantitative relations, number series, and equation building subtests. The nonverbal battery, which is entirely pictorial and diagrammatical, has three parts: figure classification, figure analogies, and figure analysis. In this study students took tests on the verbal and nonverbal batteries and two of the subtests in the quantitative battery (Test 1 and Test 2).

Ansorge (1985) in his review in The Ninth Mental Measurements Yearbook stated that the Kuder-Richardson 20 (K-R 20) reliability estimate for the multilevel edition was .96. Retest reliability after a period of six months proved to be .94. There was a reported median correlation of .78 between the verbal and quantitative battery, as well as between the nonverbal and the quantitative, across all grades. The median verbal and nonverbal correlation was r = .72.

Correlational studies proved that the Cognitive Abilities Test (CAT) had both content and construct validity. Correlations between the Cognitive Abilities Test and both the Iowa Tests of Basic Skills (ITBS--grades 3-8) and the Tests of Achievement and Proficiency (TAP--grades 9-12) proved high, particularly in the verbal area. The Cognitive Abilities Test proved to have construct validity when the multilevel batteries were correlated with the Stanford-Binet Test in the 1971-72 school year. The correlations were .65-.75 (Ansorge, 1985). Additionally, Lee and Karnes (1983) provided other evidence of validity. When the test was administered to 79 elementary gifted students in grades 4-6, significant positive correlations appeared between scores on verbal and nonverbal batteries of the Cognitive Abilities Test, Form 3 and the Ross Test of Higher Cognitive Processes. Using the Pearson r, the correlations were .44 and .22, respectively.

Academic Achievement Tests

The researcher composed six academic achievement tests, one for each skill being taught. Items from the Strategic Reasoning materials (Glade & Rossa, 1985) comprised the tests and came from all levels of difficulty included in the series (very easy, easy, easy-medium, medium, medium-difficult, difficult, and very difficult). After identifying the difficulty level of each test item, the researcher constructed tests by ranking items from very easy to very difficult, according to the difficulty levels assigned each item by the authors of the Strategic Reasoning materials (Glade & Rossa, 1985). The researcher omitted any item which had more than one correct answer or which proved difficult to score for coding to facilitate the computer data analysis.

Field-Testing. Prior to the beginning of treatment, the researcher field-tested five of the instruments (thing-making, qualification, classification, operation analysis, and seeing analogies). The field-test samples were convenience samples of middle school children from local public schools. Composition of field-tested instruments was as follows: thing-making, 30 items; qualification, 43 items; classification, 38 items; operation analysis, 25 items; and seeing analogies, 31 items. Because the instrument for structure analysis had only 7 items, the researcher retained all 7 items without field-testing this instrument. There were two purposes for pilot-testing the five instruments:

(1) to determine any items which should be removed from the tests and (2) to determine the order of the items on each test. For appropriate use in the study, the tests needed to be difficult enough to be very demanding for middle school students because the intent was to place students in a pressure situation. The researcher discarded all items on the field-tested instruments that were easy or that discriminated in the wrong direction. Because every test should contain some easy items, the researcher removed only items which 90 percent or more of the students answered correctly. The remaining items comprised the weekly achievement tests.

To intensify the testing effect, the researcher reordered the items on each test from easiest to most difficult, according to item difficulty as ascertained from the field-testing. Removing the items that were easy or that discriminated in the wrong direction made the items more sensitive to instruction.

Sample. The sample for the pilot-testing included average seventh and eighth grade students in three schools in the midlands of South Carolina. There was a different sample for each test, and both seventh and eighth graders were included in each sample. Table 2 is a summary of the five samples.

Results. All five tests contained multiple-choice items, except thing-making, which included matching items,

Table 2

Samples for Field-Testing

Test	Seventh Grade		Eighth Grade		Total
	Male	Female	Male	Female	
Thing-Making	15	14	14	10	53
Qualification	16	11	14	18	59
Classification	13	12	12	19	56
Operation Analysis	16	13	11	16	56
Seeing Analogies	10	13	16	14	53

and classification, which included some short-answer and diagrammatical items. The researcher based item difficulty computation on the percent of students getting each item correct. For items having multiple answers, such as the matching items, the researcher computed item difficulty based on the percent of correct single responses out of the possible number of correct answers (somewhat analogous to the average performance on the multiple item as a whole). A list of item difficulties appears in Table 3.

Further analysis included computation of an item discrimination index (an index reflecting whether each item discriminated between high and low scoring students and, thus, added to the variance of the test as a whole). These point biserial correlations indicated the degree to which each item was related to the test total score. For the purposes of these tests, it was not essential that every item be highly discriminating because the items were intended to range from easy to difficult, with the extremes likely having poorer discrimination values. However, negative item discrimination values indicated that the item measured something other than that which was intended. Perhaps negative values indicated problems with the item, such as misleading answers or questions. For whatever reason, removal of such items from the tests was necessary as these items were not as difficult as they were confusing. For multiple answer items, the researcher reported the

Table 3

Field-Test Item Difficulties

Item Number	Thing-Making	Qualification	Classification	Operation Analysis	Seeing Analogies
1	.98*	1.00*	1.00*	.77	.94*
2	.98*	.98*	.91*	.80	.52
3	.96	.66	1.00	.96*	.85
4	.79	.98*	1.00	.75	.44
5	.66	.93	.98*	.75	.87
6	.64	.81	.29	.41	.62
7	.51	.37	.91*	.43	.27
8	.30	.98*	.88	.84	.37
9	1.00*	.97*	.96*	.59	.56
10	.89	.97*	1.00*	.50	.71
11	.25	.64	.23	.84	.87
12	.93*	.03	.50	.32	.29
13	.39	.68	.79	.23	.54
14	.59	.29	.89	.29	.52
15	.82	.19	.66	.71	.77
16	.19	.81	.86	.32	.46
17	.34	.32	.91*	.79	.25
18	.53	.71	.52	.46	.83
19	.32	.44	.29	.29	.55
20	.61	.41	.54	.27	.29
21	.45	.25	.77	.18	.31
22	.26	.59	.86	.09	.04
23	.66	.83	.64	.16	.81
24	.47	.22	.38	.55	.46
25	.17	.68	.91*	.20	.46
26	.47	.51	.23		.48
27	.36	.34	.79		.71
28	.38	.22	.73		.71
29	.04	.22	.34		.33
30	.36	.12	.27		.44
31		.49	.89		.12
32		.47	.75		
33		.24	.20		
34		.27	.66		
35		.42	.55		
36		.17	.11		
37		.27	.30		
38		.53	.13		
39		.34			
40		.42			
41		.12			
42		.19			
43		.29			

*Items subsequently removed from their respective tests for being too easy (having item difficulties of .90 or higher).

average discrimination of the subparts of each item, although each subdiscrimination value was examined. Item discrimination values for the items on each test appear in Table 4.

After field-testing the instruments, composition of the five tests administered to students each week was as follows: thing-making, 21 items; qualification, 32 items; classification, 26 items; operation analysis, 23 items; and seeing analogies, 27 items. A summary of the deletions due to item difficulty and item discrimination appears in Table 5. The researcher omitted one item on the qualification test due to both difficulty and discrimination. See Appendix B for copies of tests.

Data Analysis

To test Hypothesis 1, the researcher used a series of six dependent *t* tests (one for each week of relaxation training). By using the *t* test, the researcher studied differences between the mean wrist temperatures prior to the relaxation training and the mean wrist temperatures immediately following the training, expecting to note significantly higher posttreatment temperatures.

The researcher tested Hypothesis 2 by examining the results of the scores on the Cognitive Abilities Test to determine differences between the pretest and posttest scores. Because students taking the test prior to instruction were a different group than the group taking the test after the instruction, the researcher used independent *t* tests in

Table 4

Field-Test Item Discrimination Values

Item Number	Thing-Making	Qualification	Classification	Operation Analysis	Seeing Analogies
1	.13	.00	.00	.29	.41
2	.13	.39	.24	.26	.07
3	.20	.19	.00	.21	.55
4	.47	.20	.00	.47	.24
5	.16	-.17*	.28	.43	.43
6	.25	.26	.11	.33	.35
7	-.15*	-.05*	.17	.43	.30
8	.02	-.07*	.17	.44	.28
9	.00	.36	.20	.44	.59
10	.29	.09	.00	.44	.67
11	-.22*	.27	.19	.19	.42
12	.36	-.16*	.56	.00	.10
13	.21	.41	.31	.24	.37
14	.36	.18	.31	.31	.23
15	.34	.14	.13	.35	.24
16	-.09*	.33	.07	.24	.50
17	.27	.16	.11	.08	.11
18	.31	.20	.27	.13	.22
19	.06	.18	.06	.21	.44
20	.42	.24	.09	.08	.29
21	.38	.05	.26	.28	.15
22	.21	.11	.47	-.08*	-.20*
23	.43	.05	.42	.12	.31
24	.32	.29	-.03*	.21	-.04*
25	-.02*	.34	.26	.09	.05
26	.41	.35	.21		.30
27	.15	.00*	.18		.12
28	.47	.13	.21		.24
29	.08	.22	.47		.43
30	.34	.18	-.01*		-.06*
31		.36	.43		.12
32		.10	.29		
33		.03	.34		
34		.21	.24		
35		.38	.39		
36		.21	.09		
37		.19	.19		
38		.23	.14		
39		.38			
40		-.05*			
41		.03			
42		.03			
43		.04			

*Denotes items subsequently removed from respective test because of low or negative item discrimination.

Table 5

Item Deletions from the Field-Testing

Test	Difficulty	Discrimination	Total Number Deleted
Thing-Making	5	4	9
Qualification	6	6	11*
Classification	10	2	12
Operation Analysis	1	1	2
Seeing Analogies	1	3	4

*Number is less than the sum of the two columns since one item is duplicated.

the analysis. The random assignment of students to groups for preassessment and postassessment meant that higher scores in the postassessment group would indicate that the instruction was effective in raising test scores.

Examination of the results of the Cognitive Abilities Test in relation to Hypothesis 3 was by independent *t* tests, also. The investigator measured differences using the postassessment scores and examined preassessment scores to ensure that there were no initial differences.

There were two ways in which the achievement test series was examined to test the fourth and fifth hypotheses. Hypothesis 4 received testing via a two-way repeated measures analysis of variance and the analysis of Hypothesis 5 was via the Pearson product moment correlation coefficients.

RESULTS

Hypothesis 1

The reported results came from the study of the following hypothesis: Peripheral temperature measures taken following relaxation training will be significantly higher than peripheral temperature measurements taken prior to relaxation training. The investigator examined the means and standard deviations of the wrist temperature measurements that were taken immediately before and after the relaxation training, as well as the difference (gain), for each of the 6 weeks of the training (see Table 6). Over the 6 weeks, there were weekly gains in wrist temperature measurements. These gains ranged from 0.4 degrees to 1.0

Table 6

Weekly Wrist Temperatures Associated with the Relaxation Training

		Prerelaxation		Postrelaxation		Difference (Gain)	
Week	N	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
1	33	90.2	1.87	91.0	2.27	0.7	1.29
2	34	90.9	2.18	91.3	2.16	0.4	1.68
3	34	91.1	1.94	91.5	2.11	0.5	1.35
4	33	91.5	1.77	92.5	1.99	1.0	1.53
5	32	93.1	1.97	94.0	1.71	0.9	1.61
6	33	91.7	1.63	92.7	2.11	1.0	1.66

degrees Fahrenheit. Although the gains were small, they were consistent and indicative of the fact that the relaxation training was effective. The peripheral temperature increases were significant 5 out of the 6 weeks (see Table 7); thus, the hypothesis that peripheral temperature increases with relaxation training was supported.

Also, the temperature gains were generally higher toward the end of the 6 weeks than they were at the beginning of the training, as were temperature readings in general, both pre and post measures (see Figures 1 and 2). This practice effect, noted in prior research by Matthews (1984), seemed to indicate that relaxing is an ongoing learning process with a cumulative effect.

Hypothesis 2

Hypothesis 2 was: Students who take the Cognitive Abilities Test after an instructional course in critical thinking skills will score higher than similar students who take the test prior to the instruction. Table 8 is a summary of the results. The means of the postassessment group were higher on all subtests, with one exception. There was a significant difference (probability < .05) on three of the subtests. Thus, there was support for the hypothesis for verbal analogies, number series, and figure analysis, but not for verbal classification, sentence completion, quantitative relations, figure classification, and figure analogies.

Table 7

t Tests on Weekly Wrist Temperature Gains

		Difference (Gain)			
Week	N	Mean	St. Dev.	t Value	Probability
1	33	0.7	1.29	3.30	.0012*
2	34	0.4	1.68	1.38	.0885
3	34	0.5	1.82	1.97	.0286*
4	33	1.0	1.53	3.75	.0004*
5	32	0.9	1.61	3.03	.0025*
6	33	1.0	1.66	3.36	.0010*

*Significant at the .05 level of significance (one-tailed test).

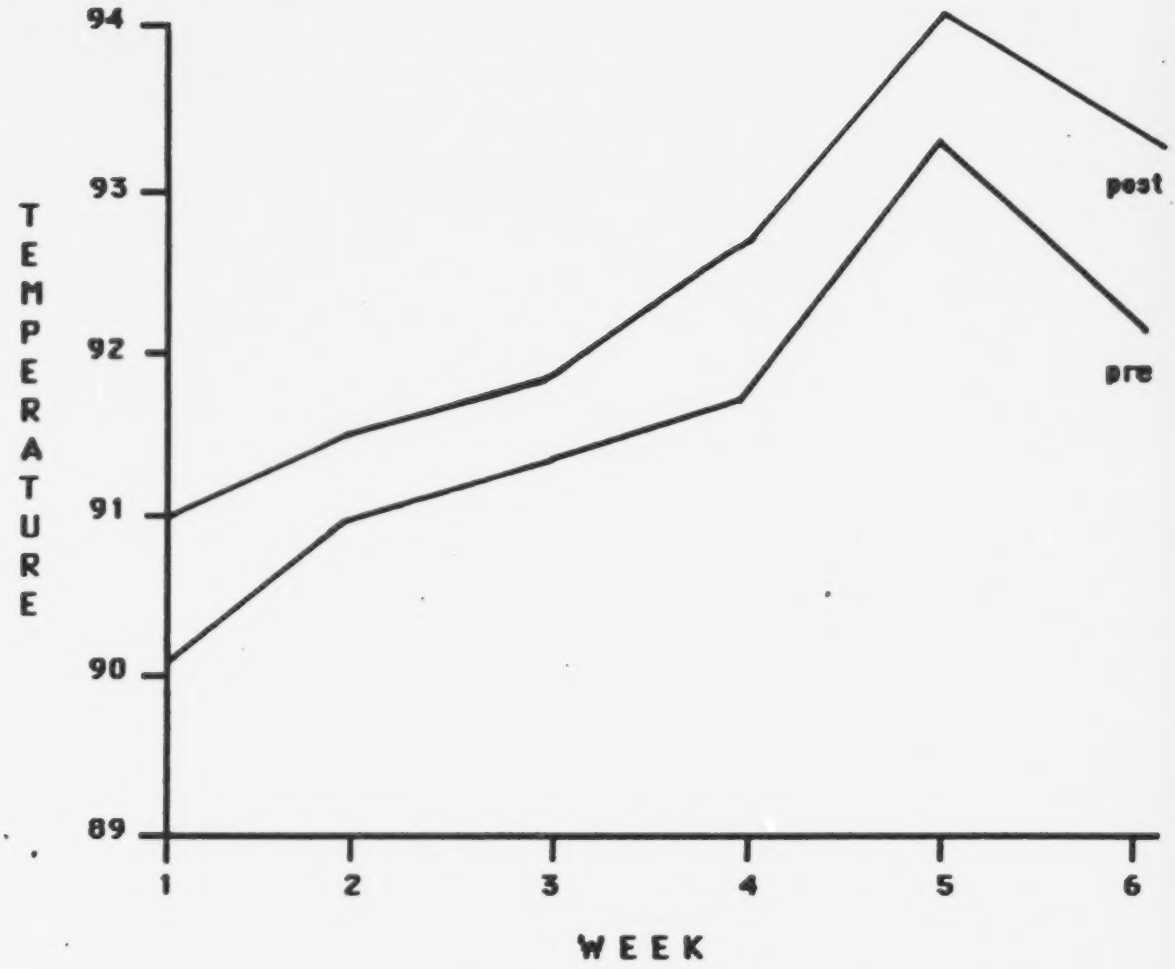

Figure 1. A Comparison of Pretemperatures and Posttemperatures.

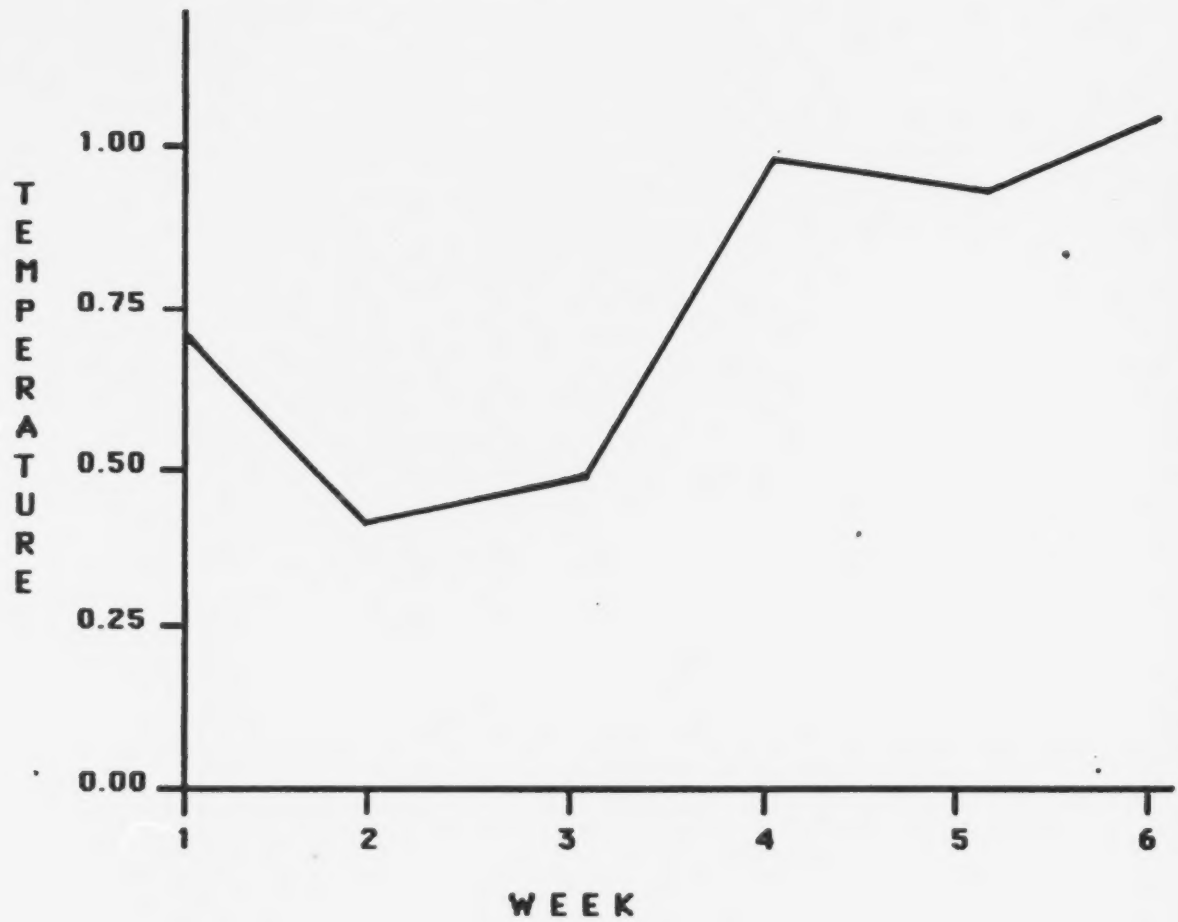

Figure 2. Pre-Post Gain in Temperature.

Table 8

t Tests between Preassessment and Postassessment Groups on the Cognitive Abilities Test

Subtest	Group*	N	Mean	St. Dev.	t Value	Probability
Verbal Classification	E	34	14.18	5.11	-0.2368	0.4068
	L	33	14.45	4.47		
Sentence Completion	E	34	19.44	6.32	-1.0670	0.1450
	L	33	20.94	5.09		
Verbal Analogies	E	34	10.00	4.79	-2.1004	0.0198**
	L	33	12.09	3.17		
Total Verbal	E	34	43.62	14.66	-1.2136	0.1147
	L	33	47.48	11.12		
Quantitative Relations	E	34	17.59	6.20	-0.4527	0.3261
	L	33	18.18	4.24		
Number Series	E	34	8.15	4.81	-2.4581	0.0083**
	L	33	11.18	5.29		
Total Quantitative	E	34	25.74	9.81	-1.5495	0.0631
	L	33	29.18	8.31		
Figure Classification	E	34	13.71	3.40	0.1065	0.4578
	L	33	13.61	4.24		
Figure Analogies	E	34	13.74	5.50	-1.0988	0.1380
	L	33	15.27	5.95		
Figure Analysis	E	34	6.06	2.99	-2.1190	0.0190**
	L	33	7.52	2.61		
Total Nonverbal	E	34	33.50	9.63	-1.2934	0.1003
	L	33	37.03	12.74		
Total Test	E	34	102.85	30.99	-1.5567	0.0622
	L	33	113.70	25.69		

* E = Preassessment and L = Postassessment

** Significant at the .05 level (one-tailed test)

Hypothesis 3

Hypothesis 3 pertained to the cumulative effects of relaxation training. Specifically, the hypothesis was: Students who receive relaxation training will score higher on the Cognitive Abilities Test on postassessment than similar students who receive no relaxation training.

The researcher examined the aspect of intervention, relaxation training, using only the postassessment group. Fifteen of the postassessment participants were members of the control group, those students receiving no relaxation training. Eighteen of the participants were members of the experimental group, the group that received relaxation training. Table 9 is a summary of the results. In every case, the experimental group scored higher, as hypothesized, than the control group; however, only three of the subtests were significantly different: verbal analogies, figure classification, and figure analysis. The total test score difference was not significant.

While the experimental and control groups were randomly assigned and, thus, were presumed to be similar, the researcher, to bolster the evidence of actual group differences, examined further the scores on the Cognitive Abilities Test by conducting *t* tests between the experimental and control groups' scores from the preassessment. There were no significant differences between the two groups (see Table 10). Because students were randomized to form preassessment and postassessment groups, students in the preassessment group

Table 9

t Tests between Experimental and Control Groups on the Cognitive Abilities Test (Postassessment Only)

Subtest	Group*	N	Mean	St. Dev.	t Value	Probability
Verbal Classification	C	15	13.80	4.51	-0.7636	0.2255
	E	18	15.00	4.49		
Sentence Completion	C	15	20.07	5.44	-0.8959	0.1886
	E	18	21.67	4.81		
Verbal Analogies	C	15	11.00	3.09	-1.8769	0.0350**
	E	18	13.00	3.01		
Total Verbal	C	15	44.87	11.84	-1.2447	0.1113
	E	18	49.67	10.32		
Quantitative Relations	C	15	18.07	4.96	-0,1370	0.4460
	E	18	18.28	3.89		
Number Series	C	15	10.00	5.71	-1.1791	0.1237
	E	18	12.17	4.85		
Total Quantitative	C	15	27.67	9.62	-0.9546	0.1736
	E	18	30.44	7.08		
Figure Classification	C	15	12.00	4.49	-2.0868	0.0226**
	E	18	14.94	3.62		
Figure Analogies	C	15	14.33	6.28	-0.8232	0.2084
	E	18	16.06	5.73		
Figure Analysis	C	15	5.80	2.11	-4.2731	0.0001**
	E	18	8.94	2.10		
Total Nonverbal	C	15	33.53	14.71	-1.4876	0.0735
	E	18	39.94	9.95		
Total Test	C	15	106.07	28.38	-1.5944	0.1210
	E	18	120.06	22.03		

* C = Control Group and E = Experimental Group

** Significant at the .05 level (one-tailed test)

Table 10

t Tests between Experimental and Control Groups on the Cognitive Abilities Test (Preassessment Only)

Subtest	Group*	N	Mean	St. Dev.	t Value	Probability
Verbal Classification	C	18	15.28	4.06	1.3184	0.1990
	E	16	12.94	5.98		
Sentence Completion	C	18	19.67	5.20	0.2129	0.8330
	E	16	19.19	7.55		
Verbal Analogies	C	18	10.83	4.48	1.0695	0.2934
	E	16	9.06	5.11		
Total Verbal	C	18	45.78	11.57	0.8873	0.3832
	E	16	41.19	17.58		
Quantitative Relations	C	18	18.44	4.96	0.8312	0.4136
	E	16	16.63	7.40		
Number Series	C	18	7.94	4.61	-0.2549	0.8006
	E	16	8.38	5.18		
Total Quantitative	C	18	26.39	8.31	0.3992	0.6930
	E	16	25.00	11.50		
Figure Classification	C	18	13.94	3.23	0.4255	0.6736
	E	16	13.44	3.66		
Figure Analogies	C	18	14.50	4.11	0.8334	0.4128
	E	16	12.88	6.77		
Figure Analysis	C	18	6.50	2.28	0.8850	0.3848
	E	16	5.56	3.65		
Total Nonverbal	C	18	34.94	7.30	0.9007	0.3766
	E	16	31.88	11.77		
Total Test	C	18	107.11	23.45	0.8234	0.4184
	E	16	98.06	38.00		

* C = Control Group and E = Experimental Group

were not the same students who were in the postassessment group; however, there was no reason to believe that the groups differed initially.

The cumulative effect of relaxation training was effective for performance in some of the subtests of the Cognitive Abilities Test. There was support for Hypothesis 3 for verbal analogies, figure classification, and figure analysis. There was no support for the hypothesis for verbal classification, sentence completion, quantitative relations, number series, and figure analogies.

Hypothesis 4

The researcher anticipated that relaxation training would affect both learning and test-taking ability, as was stated in the hypothesis: Students who receive relaxation training immediately before testing will tend to score higher on a series of achievement tests than a similar group of students who receive no relaxation training. Scores on a series of weekly achievement tests which were administered following the instructional period provided data for testing of the hypothesis. The researcher used weekly test scores as repeated measures for a two-way repeated measures analysis, where grade (7 and 8) and group (trained v. untrained) were fixed factors. There were no significant differences between the scores of the control group and the experimental group, as can be seen in Table 11. The experimental group scored slightly higher on three of the six tests; however, no significant differences were

Table 11

Results of the Analysis of the Achievement Test Series

Source	DF	Sum of Squares	F Value	Probability
Group	1	37.18	0.48	0.4934
Grade	1	33.56	0.43	0.5152
Group*Grade	1	120.49	1.54	0.2198
Error	55	4301.19		

found. Thus, the researcher rejected Hypothesis 4. The means for the experimental and control groups appear in Table 12.

Hypothesis 5

The last hypothesis was: Achievement test scores will be positively related to the degree of relaxation as measured by peripheral temperature. The six weekly correlation coefficients for the linear association between test score and wrist temperature appear in Table 13. Only once, in Week 6, was the association significant; thus, the hypothesis was not supported.

A detailed examination of the data revealed unusual differences between the control and experimental students. Correlations between peripheral temperatures taken immediately prior to testing and weekly test scores for the two groups are in Table 14. The most obvious trend was the negative correlations for the experimental group versus positive ones for the control group. Students in the control group who had high temperatures tended to score higher on the achievement tests than students who had low temperatures. In the control group, students who had low peripheral temperatures tended to score higher on the tests than students who had high peripheral temperatures.

Assuming that peripheral temperature was an appropriate measure of the background stress level, the researcher suspected that the more relaxed a student was,

Table 12

Means and Standard Deviations on the Achievement Tests

	Experimental			Control		
Week	N	Mean	St. Dev.	N	Mean	St. Dev.
1	34	32.15	9.16	33	33.45	7.49
2	34	15.88	3.99	32	15.88	4.80
3	34	26.09	4.70	31	24.94	4.84
4	33	12.24	3.12	34	12.71	2.98
5	33	18.76	3.24	33	17.88	2.96
6	33	15.94	5.70	33	14.42	4.42

Table 13

Correlations between Weekly Test Score and Peripheral Temperature (Total Group)

Week	N	Pearson's r	Pr > r
1	67	-0.12	0.32
2	66	-0.01	0.90
3	65	-0.10	0.42
4	67	0.08	0.52
5	65	0.17	0.17
6	65	0.28	0.02*

*Indicates significant Pearson's r at 0.05 level of significance.

Table 14

Correlations between Peripheral Temperature and Achievement Test Scores by Groups

Week	Control	Experimental
1	0.07	-.29
2	0.04	-.01
3	0.15	-.42
4	0.41	-.08
5	0.26	-.05
6	0.41	..09

the better he or she would score on a test. This assumption appeared to be true for the control group; however, data from the experimental group seemed to indicate the opposite. For the experimental group, it was as if the relaxation training caused the relaxed students to score poorly. The general levels of relaxation in the two groups needed to be examined further.

Each student received testing six times on six different weekly tests, with a concomitant wrist temperature, measured just prior to testing. Because the weekly test score distribution differed from week to week, having differing weekly means and variances, it was impossible to compare directly scores from one week with scores from another week. The researcher transformed the scores of each of the six weekly test to z scores by subtracting the weekly mean and dividing the difference by the standard deviation of the weekly score distribution. The researcher constructed a new data set in which all pairs of scores (weekly z scores and wrist temperature) were considered. Thus, a student who answered each of the six tests contributed six pairs of measures to this new data set. Aggregation of these six pairs of data was by (1) sorting the pairs by wrist temperatures within intervals of one Fahrenheit degree and (2) computing the mean test z score within that interval. The researcher ignored any temperature interval with fewer than five pairs of scores; therefore,

temperatures less than 86° Fahrenheit and greater than 97° Fahrenheit were eliminated, as was the 96° Fahrenheit temperature interval.

The results of this analysis appear in Figure 3. Because the method of aggregation created dependencies among the data (six scores from a single student, for example), standard statistical tests had limited utility here. A curvilinear trend seemed strongly suggested by the data in Figure 3, however. There was an observable tendency for the highest test performance to occur between 90° Fahrenheit and 93° Fahrenheit. As wrist temperature became more extreme from this optimum wrist temperature range in either direction, test performance tended to suffer.

A possible explanation for the curvilinear trend was as follows: When students relaxed slightly, their anxiety levels dropped, but remained strong enough to motivate concentration and to keep the students hard at work. It is possible that relaxing beyond that point may have discouraged concentration and work. Relaxation, like so many other useful activities, may be overdone.

CONCLUSIONS

Poised, calm reflection, freed from anxiety, fortified against distracting fragments of variant thought, seems unarguably associated with powerful, effective thought, learning, and test performance. The argument appeals not only for its grounding in learning theory but also from subjective mental experience, as well. Serene concentration

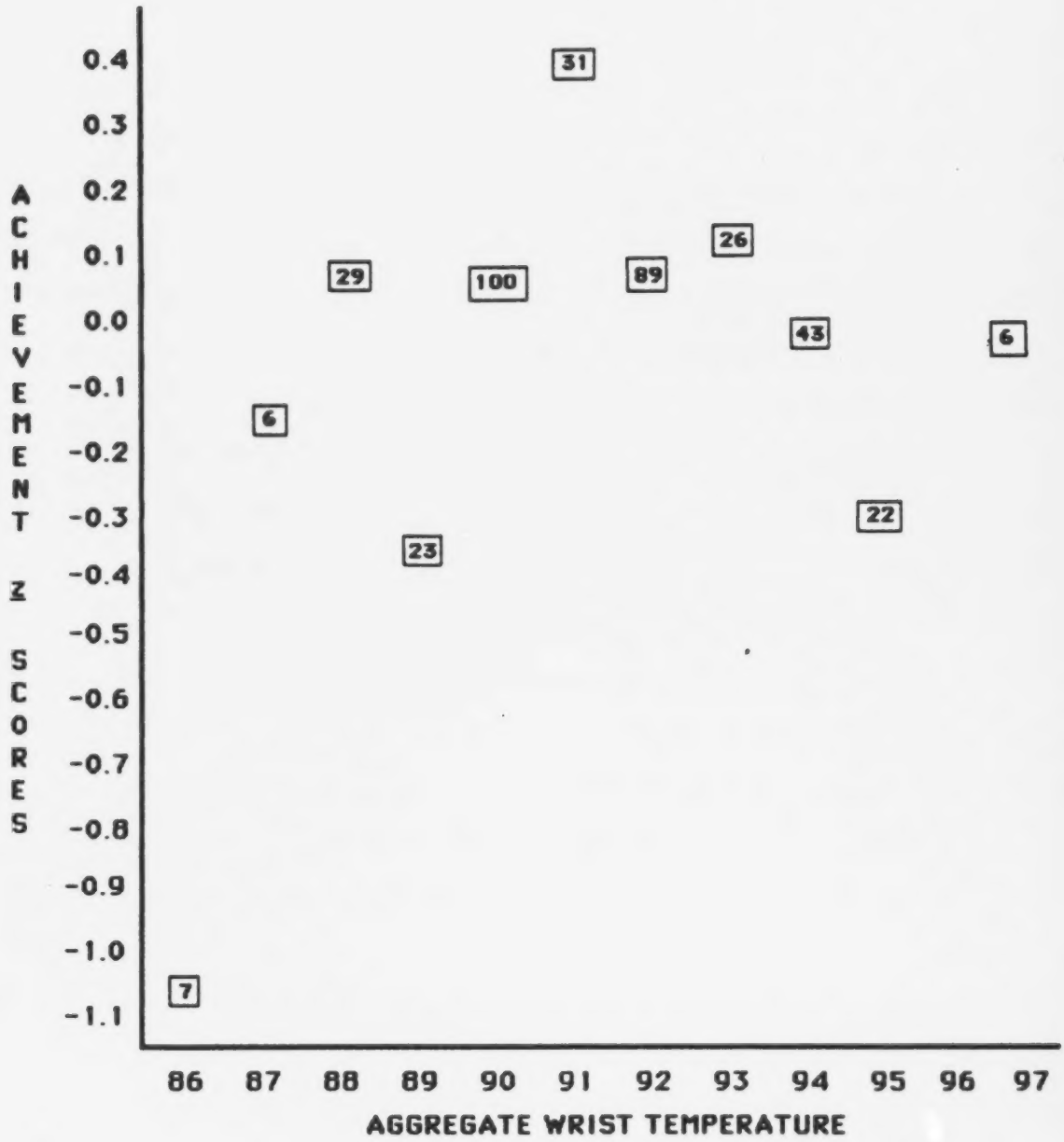

Figure 3. Plot of Mean Test Performance, Expressed as z Scores, by Wrist Temperature Aggregated at Intervals of One Fahrenheit Degree.

Note: ☐ = Number of students.

is the ideal mental environment for any cognitive work, or people in such work would not avidly pursue it. Why, then, do studies such as this one produce such a mixed bag of results? Should not students who undergo relaxation exercises prior to a test outperform a comparable group who go without the exercises? Results of this study allow insight into the failure of relaxation exercises to improve immediate test performance and suggest a more sophisticated view of relaxation as a concept.

The experimental group's lackluster performance on the weekly tests could be attributed to ineffective relaxation strategies which left students untouched. That this view is wrong is clearly evidenced by the support given for Hypothesis 1: Students' wrist temperatures warmed under relaxation training, an outward sign of an inward change.

Maybe the experimental group's failure to outperform the control group is attributable to the relatively high level of relaxation which <u>all</u> students brought to the testing situation. Clearly, relaxation exercises would make more of a difference for tense, anxious students than for relaxed, carefree students. The relatively high mean wrist temperatures of both groups tend to foster this theory. If the sample were limited to students with higher than normal levels of stress, the outcome likely would have been quite different; however, that conclusion must await further study. By studying Figure 3, which is suggestive that relaxation can be overdone, one notes the revelation

of a major finding of this research. The danger of relaxing a student beyond an optimum level is particularly likely to happen in a situation where relaxation occurs in a group which is directed by a leader. The relaxation response is pleasurable at whatever level of relaxation it is invoked. In a group, the inferred goal would seem to be: "Relax as thoroughly as possible." While such a goal may improve the test performance of anxious students, it may relax others to sluggishness. Anyway, it is not the goal one would prefer to communicate. Instead, a better goal is: "Search yourself for troublesome signs of stress and, on finding them, relax until they become manageable." In this context, elimination of stress, or its management, becomes the goal, not the invocation per se of the relaxation response. Relaxation is seen as a means to foster performance, not an end in itself. Subsequent study in this series should have two objectives: (1) to adopt methods which pursue relaxation as an occasional skill to be used when stress intrudes upon efficiency and (2) to develop simple tools for identifying students under debilitating levels of stress. By achieving these objectives, researchers could focus their efforts on students in greatest need of help and could avoid problems of over-relaxation which appear in the present study.

The partial support given for Hypothesis 3, even though the relaxed group tended to be over-relaxed for weekly tests, is indicative of the fact that the experimental group underwent changes which caused improved

performance in three areas of the Cognitive Abilities Test. While the exact mechanism of this change is open to conjecture, probably the skill they learned in the relaxation exercises transferred to better stress management in the coursework for the experimental group. Of course, the improved performance could be another case of the infamous Hawthorne Effect, against which the experimental design of this study is ineffective. The researcher was unable to design a study which would generate the necessary data at an acceptable cost while keeping subjects blind to their participation in an experiment; therefore, the Hawthorne Effect must be considered as a possibility, however improbable.

Because of the results of this study, there must be considerable doubt on the use of whole-class relaxation exercises before test administration for average, not particularly anxious, students. Whole-class relaxation exercises should be reserved for:

1. groups of stressed, anxious students;

2. groups learning to achieve the relaxation response as opposed to groups whose primary objective is otherwise (e.g., improved test performance or learning); and

3. groups who need to be "settled down," after heavy exercise, stimulation, or play, with the caveat that students can become too relaxed to be good learners.

Instead of using relaxation as a group activity, students should learn to recognize signs of stress and invoke strategies for its management. Neither relaxation nor the management of stress seems a valid ultimate objective for educators. Rather, each is a strategy by means of which broader educational goals, such as improved learning and increased performance on educational tasks, may be realized.

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APPENDIX A

Test Anxiety

Each of us, at some time in life, fears something or possesses a built up anxiety towards performing a certain task. The fear or anxiety may be the result of a prior bad experience or may be a reflection of an inner self-conflict which may manifest itself in feelings of inadequacy. The anxiety may be caused, also, by the fact that one has never been exposed to the specific circumstance; therefore, as is often the case, one fears the unknown.

It is possible to overcome these feelings of fear, anxiety, and inadequacy. One can change one's self-concept and feelings which may cause inner conflicts by using a relaxation technique known as guided imagery. The relaxation exercise you are about to hear uses this technique.

In order for any relaxation technique to be effective, one must prepare oneself for the relaxation experience. Sit erect in the chair with your feet flat on the floor and a few inches apart. Close the eyes. You can relax easier and clear the mind of outside disturbances better if the eyes are closed rather than opened. Practicing deep breathing is an excellent way to prepare oneself for the relaxation experience. Inhale, pulling air into the lungs with a long, slow breath. Hold the breath for just a second. Become aware of the way the rib cage has risen and expanded to accomodate the air you inhaled. Now, exhale, pushing the air out of the lungs until you feel that the lungs are completely void of air. Try taking

another deep breath. Inhale, pulling the air into the body through imaginary holes in the feet. Experience the calming sensation as the air forges upward through the legs to the body. Feel the muscles of the legs begin to relax as the air travels through the calves and thighs. Pull the air further upward into the body cavity until it reaches the lungs and fills the lungs to capacity. Again, hold the breath for a short time. Now, exhale, using all the force of your muscles to push the air out of the lungs. Feel the relaxing sensation that comes over you as the air is forced downward, out of the body, into the thighs and calves, and out of the imaginary holes in the bottom of the feet. While listening to the music, breathe in and out, remembering to take deep breaths. (Music--approximately 1 minute) At this time, your body should be relaxed, not tense. You are ready to begin the guided imagery exercise.

Think of an instance in your life when you were afraid to attempt a specific task. Perhaps, you were unprepared for a test and afraid to enter the classroom to take the test. You can overcome your fear or anxiety, no matter what it is, through the use of relaxation techniques. Now that you are prepared to use guided imagery, let's do just that and begin to combat those fears and anxieties.

Some people are "test shy". This means that these people become tense when taking tests and, as a result, often freeze and forget the material they have studied.

Can you think of an instance when you were really anxious about taking a certain test? Listen to the music for a moment while you try to picture yourself taking the test you were afraid to take. (Music) Try to analyze the situation. Why are you anxious about taking the test? Are you improperly prepared for the test? Do you not fully understand the material being covered on the test? Or, are you simply feeling a little insecure and afraid you may not perform up to the expectations of others? If either of these reasons is why you fear the test, what can you do to alleviate the problem? In either of these instances, the best possible solution is to come to the test prepared. Be sure that you have studied sufficiently and are knowledgeable in the subject on which you are going to be tested. If you are not able to comprehend the material, perhaps a friend could help you study. Or, surely, your teacher would be willing to give you some extra help if she knew you wanted it. Before you even seek help, though, you must make up your mind that you <u>can</u> learn the subject matter and <u>can</u> do well on the test. Now, relax. Breathe deeply. Inhale while counting, "One, two, three...." Exhale, "Four, five, six...." Relaxing prior to studying will help the mind retain information. Listen to the music while you breathe deeply and relax. (Music) Study in a quiet place where you feel secure and comfortable. See how easily you retain the material studied when you are calm and relaxed. (Music)

The time of trial is here--today is the day you will take the test for which you have been preparing. As you approach the classroom, you are a little apprehensive even though you know you have prepared yourself to the best of your ability. Get rid of the tension you are feeling. Sit in your desk and concentrate on relaxing for a minute or two. Remember that deep breathing can help you relax and regain your composure. Forget about the test and just concentrate on relaxing. Listen to the music while you practice deep breathing and relax. (Music) Inhale. Pull air into the lungs until the rib cage has expanded to its fullest capacity. Hold the breath for a second. Now, exhale. Force the air slowly and deliberately out of the lungs. Repeat this process one more time. This time try blowing the air out of the lungs. Can you feel yourself becoming calm and relaxed? Feel the tension subsiding? Yes, you are calm and confident. Look at the first page of the test. Do you see any questions that you are sure you can answer? If so, answer those first. Proceed in this manner through the whole test, answering the questions that you are confident you can answer correctly. Are you surprised at the number of questions you know? Taking tests seems easier when you are relaxed. While remaining calm and confident, go back through the test and try to answer the questions that you omitted the first time. Do not let yourself become unnerved. You have prepared yourself

both mentally and physically for this test. If you feel yourself becoming tense, stop for a minute and practice your deep breathing exercises. Remember, you are in control and function at your best when you are calm and relaxed, and you can practice your breathing exercises at any time and in any place. When you finish the test, hand it to the teacher with confidence, assured by the fact that you have performed to the best of your ability. You prepared yourself properly and remained calm while taking the test. You are sure that you have done well on this test. Before leaving the classroom, practice your deep breathing once more so that you can maintain the air of confidence and pride in achievement that you feel toward yourself right now. (Music)

As you open your eyes and become acclimated to your surroundings, always remember that you have the power within you to control excessive amounts of anxiety.

APPENDIX B

Name _____ Date _____

Grade _____ Score _____

THING-MAKING

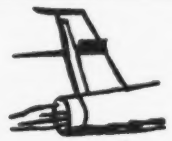
1. Match each use of cog with the appropriate meaning at right.

The eighth cog is broken.	A	a	
There are twenty-four teeth on this cog.	B	b	
Too often, the bright college graduate becomes a mere cog in the machinery of business.	C	c	

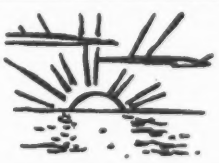
2. Match each use of the word volume with the corresponding meaning at right.

The volume is nine cubic centimeters.	A	a	Book, especially one of a series
Turn down the volume.	B	b	Quantity of space bounded by three dimensions
"Once upon a midnight dreary, while I pondered, weak and weary, Over many a quaint and curious volume of forgotten lore..." Edgar Allan Poe, The Raven	C	c	Degree of loudness
As the transaction volume mounts, accounting controls increase in importance.	D	d	Quantity, amount, or number of something

3. Match each use of jet with the correct meaning at right.

The jet made a crash landing.	A	a	 Stream of gas
She was an oriental figurine: emerald eyes, ivory skin, jet hair.	B	b	Lustrous black
Increasing its force, the hot jet lifted dust, bits of paper, and small pebbles from the runway.	C	c	Airplane which is jet-propelled

4. Match each use of the word radiant with the corresponding meaning at right.

"Sorrow for the lost Lenore-- For the rare and radiant maiden whom the angels name Lenore-- Nameless here for evermore." Edgar Allan Poe, The Raven	A	a	Showing happiness, joy
Like a radiant star, his soul shone with a brilliance of its own, cold, distant, pure white.	B	b	 Shining brightly

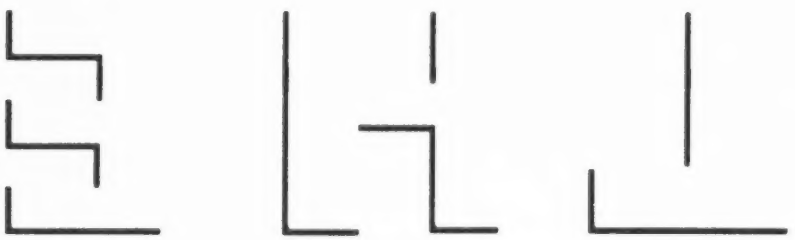
5. How does the meaning of <u>mother</u> shift from the first sentence to the second?

   John's <u>mother</u> is fifty-three years old.

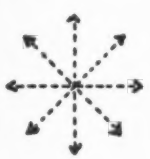
   Where is the colt's <u>mother</u>?

   (a) by operation analysis (stage to operation)
   (b) by structure analysis (whole to part)
   (c) by classification (species to genus)

6. What do the lines below represent? Can you make an object "pop" into view?



7. Match each use of the word space with the proper meaning at right.

But will it fit in the space available?	A	a	A length of time; an interval between two points of time
A Russian, not an American, was the first man to enter space.	B	b	A distance, area, or volume between things or limits
The space between birth and death is much too short.	C	c	Outer space, the universe beyond Earth's atmosphere
"Somewhere, beyond space and time, Is wetter water, slimier slime..." Rupert Brooke, Heaven	D	d	 The unbounded volume of nothingness in which objects reside; opposite of matter

6. Match each use of the word flower with the proper meaning at right.

She plucked the flower from its stem.	A	a	Flowering plant
"A simple maiden in her flower is worth a hundred coats-of-arms." Alfred, Lord Tennyson, Lady Clara Vere de Vere	B	b	A figure of speech, as "The Lord is my shepherd."
This flower has bifurcate leaves.	C	c	Blossom
"The poet knows that he speaks adequately, then, only when he speaks somewhat wildly, or 'with the flower of the mind.'" Ralph Waldo Emerson, The Poet	D	d	Period of flourishing; youth

9. Albert kissed Jan seven times. Jan kissed Albert five times. How many times did they kiss each other? If the answer is five, which of the following is the most probable meaning of kiss?

   (a) Caress with the lips (by one person)
   (b) Reciprocal caress with the lips between two people
   (c) A gesture with the lips, not involving physical contact with another person, as "to throw a kiss"
   (d) A trace or small amount of something, as "a kiss of lemon"

10. How does the meaning of stroke shift from the first sentence to the second?

    He took a short stroke, then turned for the last lap.

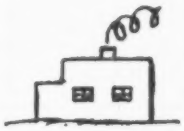
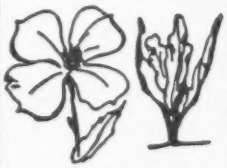
    His best stroke is the Australian Crawl.

    (a) by operation analysis (operation to part)
    (b) by operation analysis (stage to operation)
    (c) by classification (species to genus)

11. Match each use of the word train with the proper meaning at right.

"Train up a child in the way he should go; and when he is old, he will not depart from it." Proverbs	A	a	A trailing stream
They trained their guns on the condemned man, firing in unison.	B	b	A number of people following an example, as if they were the retinue of a prince
"The son of God goes forth to war, A Kingly crown to gain; His blood-red banner streams afar; Who follows in his train?" Bishop Reginald Heber, The Son of God Goes Forth	C	c	A connected sequence, succession, or series
She interrupted his train of thought.	D	d	Railroad cars pulled by one or more locomotives
"Glorious the sun in mid-career; Glorious th' assembled fires appear; Glorious the comet's train..." Christopher Smart, Song to David	E	e	To educate, instruct, rear
"Train up a fig tree in the way it should go, and when you are old, sit under the shade of it." Charles Dickens, Dombey and Son	F	f	To aim or direct
"Sure, the next train has gone ten minutes ago." Punch, vol. lx, (1871)	G	g	To direct growth by pruning, bending, binding, etc.

12. Match each use of the word plant with the proper meaning at right.

Both sides of the river were dense with plants and trees.	A	a	A member of the vegetable kingdom
He could not plant a blow squarely.	B	b	To place or land, as a blow
"Persecution is a bad and indirect way to plant religion." Sir Thomas Browne, Religio Medici	C	c	 The building, land, apparatus, etc. of an industrial firm
Some plankton are animals, others are plants.	D	d	 A soft-stemmed member of the vegetable kingdom, as opposed to a shrub or tree
The plant is worth much more than the inventory.	E	e	To establish, found, settle, inculcate, as a colony or an idea

13. Match each use of the word moon with the proper meaning at right.

"Hey diddle diddle, The cat and the fiddle, The cow jumped over the moon..." Mother Goose's Melody	A	a The natural satellite of any planet
"What in its ruddy orbit lifts the blood, Like a perturbed moon of Uranus, Reaching to some great world in ungauged darkness hid..." Coventry Patmore, The Unknown Eros	B	b Earth's natural satellite
"You saw the moon from Sussex Downs, A Sussex moon, untravelled still, I saw a moon that was the town's, The largest lamp on Campden Hill." G. K. Chesterton, The Napoleon of Notting Hill, dedication	C	c The appearance of Earth's satellite at a particular time

14. How does the meaning of bowl shift from the first sentence to the second?

His toe crossed the line as he bowled.

He bowled a good game.

(a) by qualification (quality to thing)
(b) by operation analysis (stage to operation)
(c) by analogy

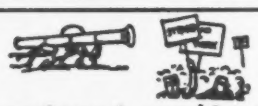
15. How does the meaning of church shift from the first sentence to the second?

"This church was built in 1923."

"She is active in the church."

(a) by classification (genus to species)
(b) by qualification (thing to quality)
(c) by structure analysis (part to whole)

16. Match each use of the word face with the proper meaning at right.

She made a face.	A	a	Front surface of a person's head
"And the Spirit of God moved upon the face of the waters." Genesis	B	b	A grimace; an expressive facial distortion
Face me when you speak!	C	c	Countenance; expression of emotion
"Bowed by the weight of centuries he leans Upon his hoe and gazes on the ground, The emptiness of ages in his face..." Edwin Markham, The Man with the Hoe	D	d	Symbolic or marked surface, as of a clock or playing card
Challenges never evaporate; they must be faced.	E	e	A thing's prominent surface, whether upper, front, or outer
Turning the card's face up, he revealed a queen.	F	f	 To confront a situation with courage and fortitude
"I have heard of your paintings too, well enough. God hath given you one face, and you make yourselves another." William Shakespeare, Hamlet	G	g	To be positioned with the face toward someone or something

17. Is state a synonym of nation?

(a) yes (b) no (c) sometimes

18. Match each use of the word man with the proper meaning at right.

"The Simiadae then branched off into two great stems, the New World and the Old World monkeys; and from the latter at a remote period, Man, the wonder and the glory of the universe, proceeded."

Charles Darwin,
The Descent of Man

A a

Adult male human being

"The Book of Life begins with a man and a woman in a garden."

Oscar Wilde,
A Woman of No Importance

B b

Human being, regardless of age or sex

"To every man upon this earth death cometh soon or late."

Thomas Macaulay,
Lays of Ancient Rome, Horatius

C c

Human beings collectively, mankind

19. How does the meaning of mushroom shift from the first sentence to the second?

    Is that a poisonous mushroom?

    An atomic mushroom does not always accompany a nuclear explosion.

    (a) by thing-making (thing to similar thing)
    (b) by qualification (thing to quality)
    (c) by structure analysis (part to whole)

20. "Words often grow new senses. For example, the word squeak comes from the word mouse." Is this an accurate statement?

21. One of the words in the box is the most ambiguous in the English language. Which word?

THING	LOVE
GOD	SET
POINT	FREEDOM
IN	SPACE

Name _____ Date _____

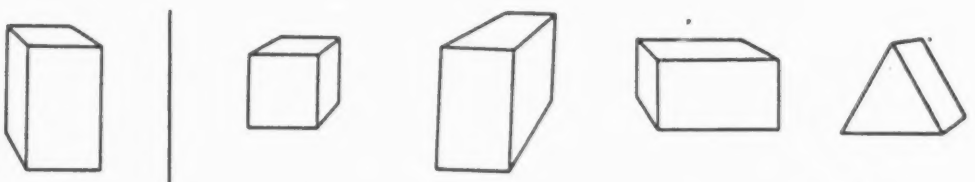
Grade _____ Score _____

QUALIFICATION

1. Which object (a, b, c, or d) is the same as the one at left?

a b c d

2. Which item (a, b, c, or d) is the same as the one at left?



a b c d

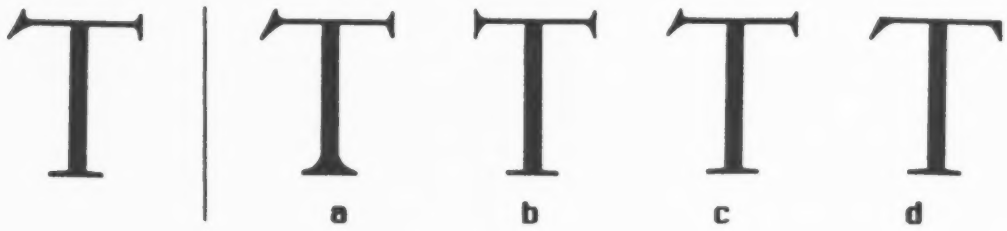
3. Which word (a, b, c, or d) is the opposite of the first?

OPPOSITE

SAME DIFFERENT QUALITY ABSTRACT

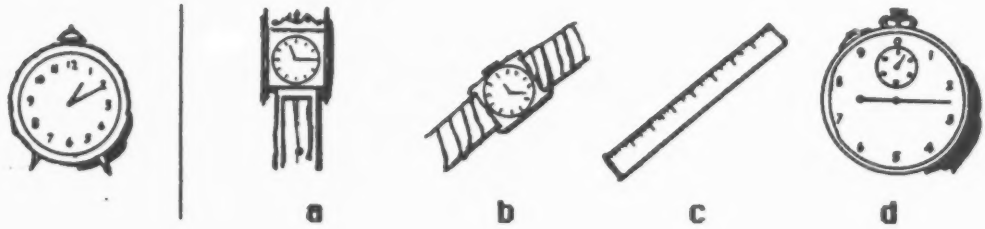
a b c d

4. Which item (a, b, c, or d) is the same as the one at left?

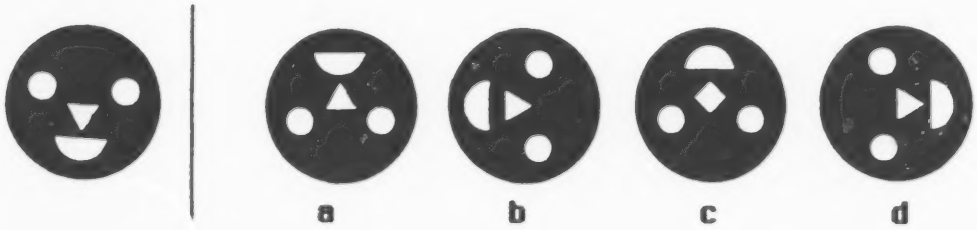


5. Which drawing (a, b, c, or d) is the opposite of the one at left?

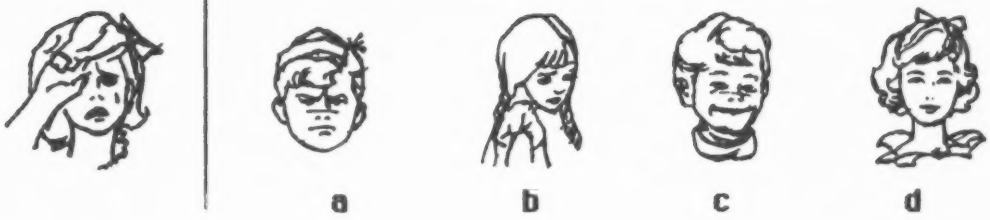
6. Which object (a, b, c, or d) is the opposite of the one at left?



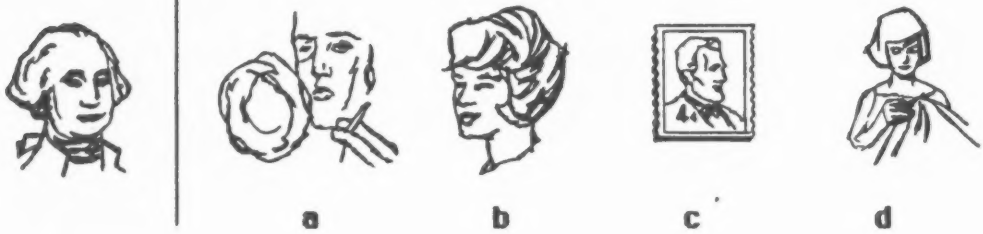
7. Which drawing (a, b, c, or d) is the same as the one at left?



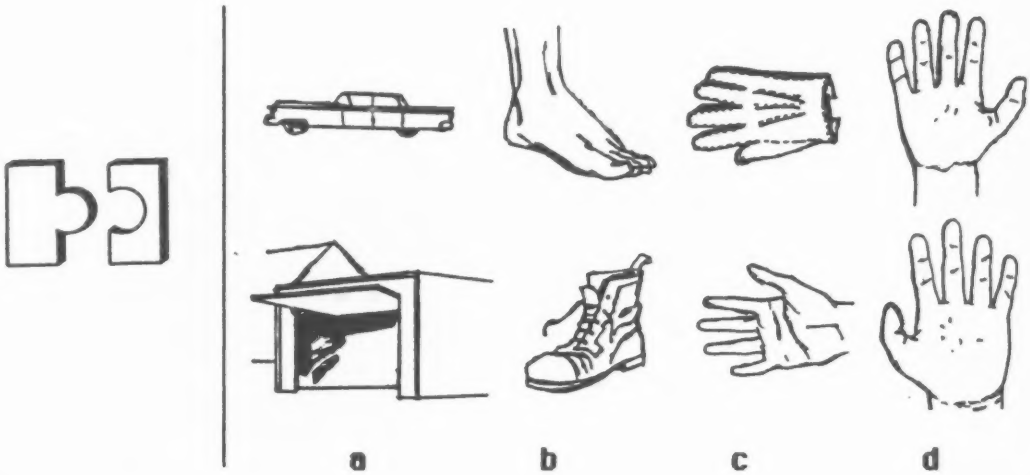
8. Which drawing (a, b, c, or d) is the opposite of the one at left?



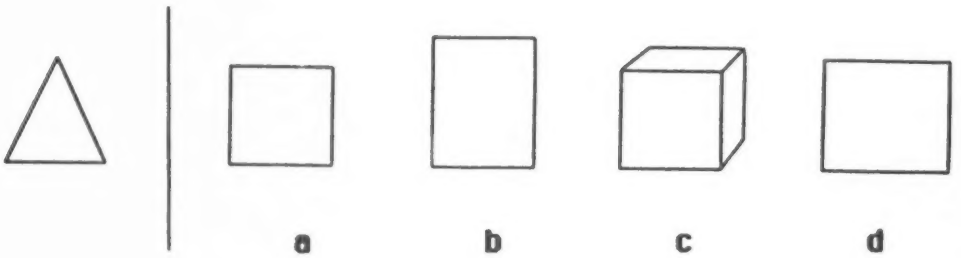
9. Which drawing (a, b, c, or d) is the opposite of the first?



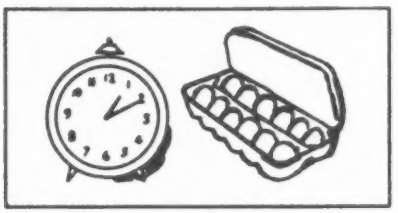
10. Which pair (a, b, c, or d) is the opposite of the one at left?



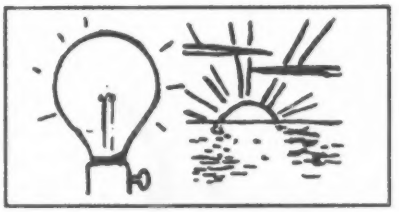
11. Which drawing (a, b, c, or d) is the opposite of the one at left?



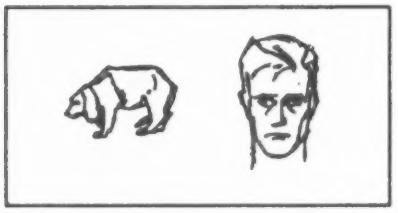
12. What type of quality does each box show? Sensory (S), emotional (E), or logical (L)?



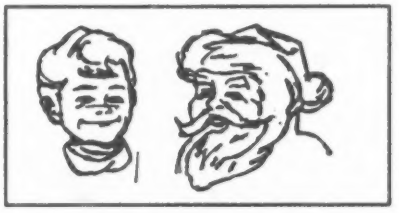
S, E, or L?



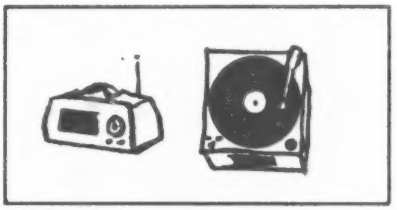
S, E, or L?



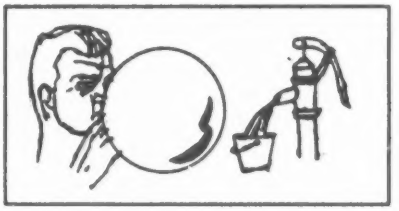
S, E, or L?



S, E, or L?



S, E, or L?



S, E, or L?

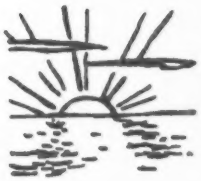
13. Which word (a, b, c, or d) is the opposite of the first?

RED	YELLOW	BLUE	COLOR	VIOLET
	a	b	c	d

14. Which object (a, b, c, or d) is the opposite of the first?

a b c d

15. Pick the object (a, b, c, or d) which is the opposite of the first.



a b c d

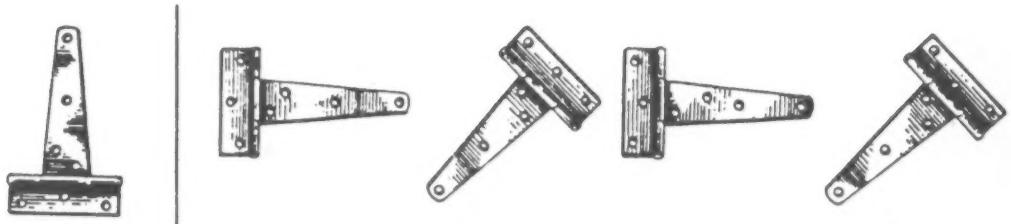
16. Pick the letter (a, b, c, or d) which is the opposite of the first letter.

B	a	D	E	Z
	a	b	c	d

17. Which term (a, b, c, or d) is the opposite of the one at left? Why?

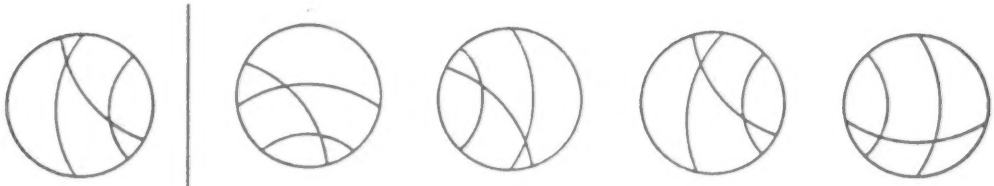
	a	b	c	d
ABRAHAM LINCOLN	PENCIL	EIFFEL TOWER	TORONTO	NORTH POLE

18. Which object (a, b, c, or d) is the same as the one at left?



a b c d

19. Which drawing (a, b, c, or d) is the same as the one at left?



a b c d

20. Which item (a, b, c, or d) is the opposite of the one at left?

	a	b	c	d
ANIMAL MAMMAL DOG	DAY MONTH YEAR	QUALITY COLOR GREEN	PARAGRAPH SENTENCE WORD	TREE BRANCH TWIG

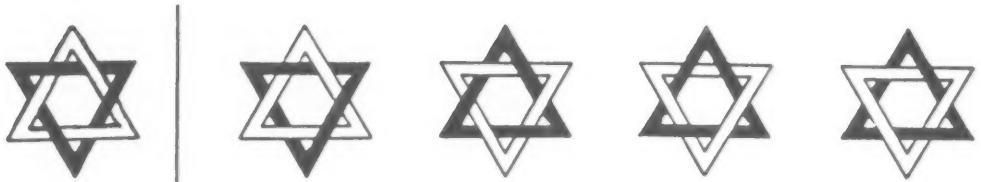
21. Which pair of words (a, b, c, or d) is the opposite of the pair at left?

WHITE BLACK	HOT COLD	BAD EVIL	CAUTIOUS BOLD	FAST SLOW
	a	b	c	d

22. Which set of words (a, b, c, or d) is the opposite of the set at left?

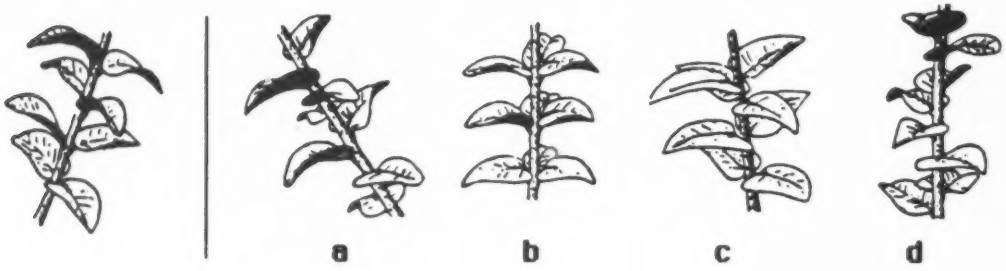
TOE FOOT LEG	TWIG BRANCH TREE	PLANET SOLAR SYSTEM GALAXY	WORD SENTENCE PARAGRAPH	EARTH UNITED STATES TEXAS
	a	b	c	d

23. Which item (a, b, c, or d) is the same as the one at left?



a b c d

24. Which drawing is (a, b, c, or d) the same as the first?



a b c d

25. Which letter (a, b, c, or d) is the opposite of the one at left?

S | N E W S

a b c d

26. Which drawing (a, b, c, or d) is the same as the one at left?

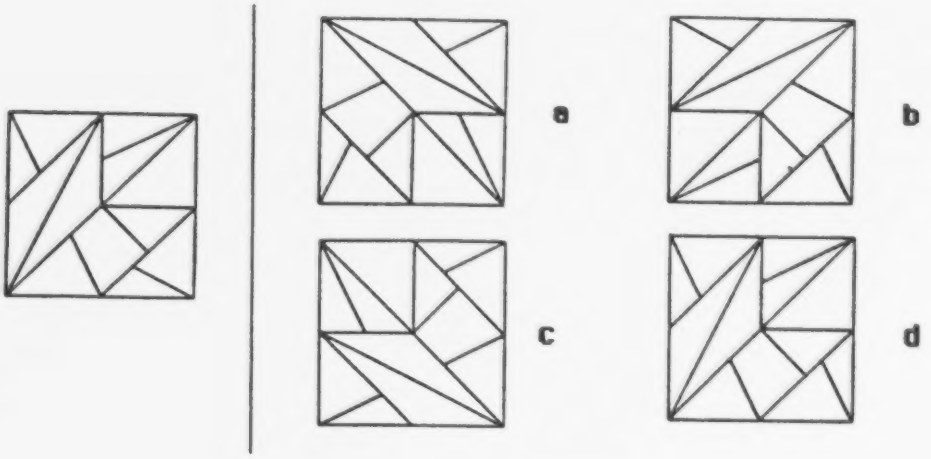
a b c d

27. Which drawing (a, b, c, or d) is the opposite of the one at left?

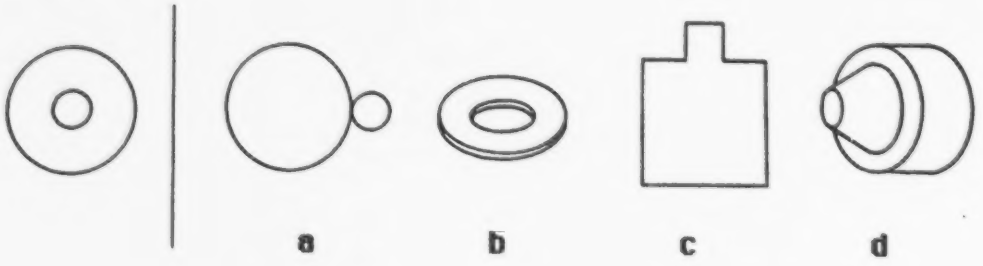
a b c d

28. Which drawing (a, b, c, or d) is the opposite of the first drawing?

29. Which drawing (a, b, c, or d) is the same as the one at left?



30. Which object (a, b, c, or d) is the same as the first?

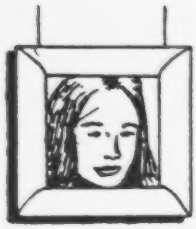


31. Which item (a, b, c, or d) is the same as the one at left?

a

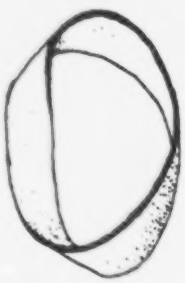
b

c

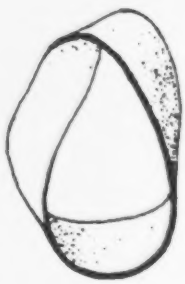


d

32. Which item (a, b, c, or d) is the same as the first?



a



b

c

d

Name _____ Date _____

Grade _____ Score _____

CLASSIFICATION

1. Which drawing (a, b, or c) belongs with the two at left?

a b c

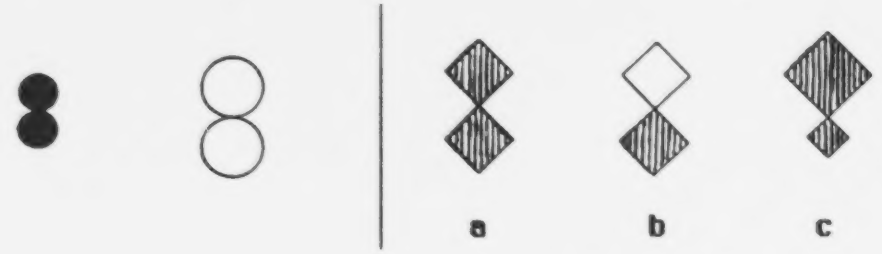
2. Which object (a, b, or c) belongs in the same class with the two at left?

a b c

3. Which object (a, b, or c) belongs with the two at left?

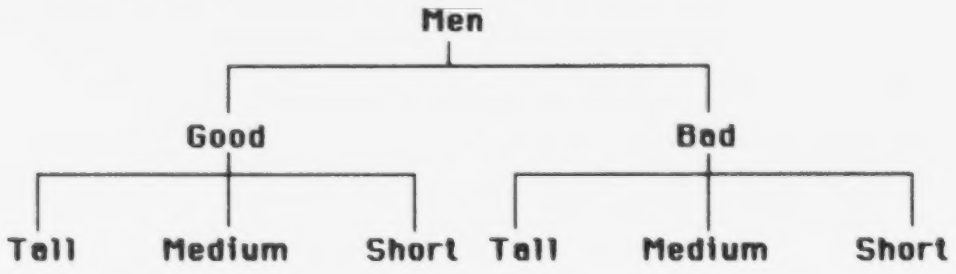
a b c

4. Which item (a, b, or c) belongs with the two at left?



5. Which drawing (a, b, or c) belongs with the two at left?

6. Make a classification diagram of the circles below. For example, if you were to classify men, you might make a diagram such as the one shown.



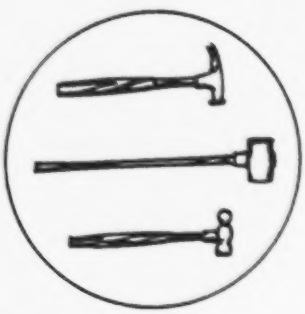
7. Which object (a, b, or c) goes in the same class with the two at left?

a b c

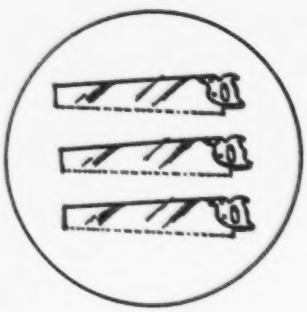
8. Which picture belongs with the two at left?

a b c

9. Which answer (a, b, or c) belongs in the same class with the first two groups?



a



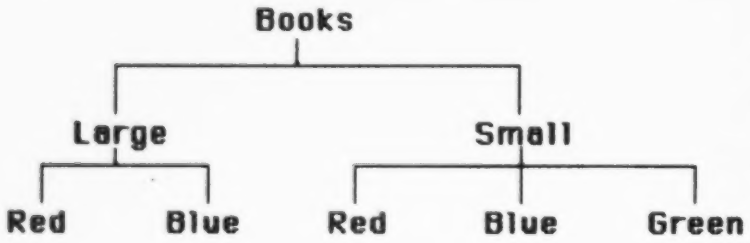
b

c

10. Which drawing (a, b, or c) belongs in the same class with the two at left?

a b c

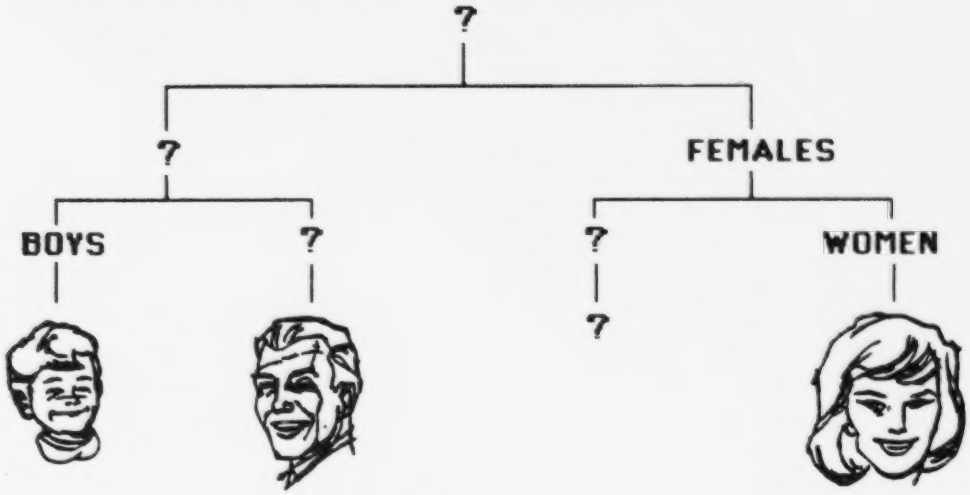
11. Classify the people at right according to emotional expression and sex, making use of a two-level diagram. For example, books (below) are classified according to size and color. This exercise has no other purpose than the practice it gives in classification.



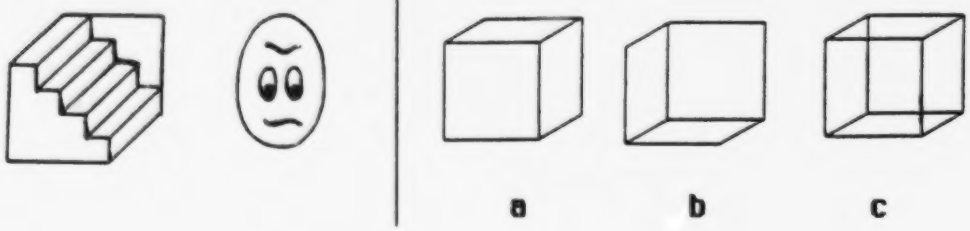
12. Which answer (a, b, or c) goes with the two objects at left?

a b c

13. Complete the classification diagram begun below. In what ways might the items be classified other than sex and age?



14. Which drawing (a, b, or c) belongs with the two at left?



15. How does the meaning of <u>fish</u> shift from the first sentence to the second?

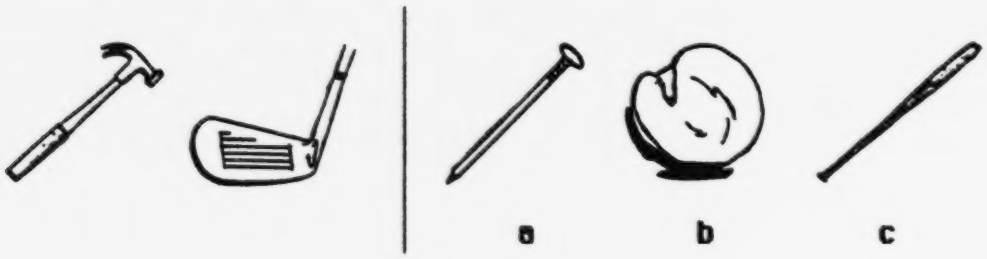
A whale is a mammal, not a <u>fish</u>.

A whale is an air-breathing <u>fish</u>.

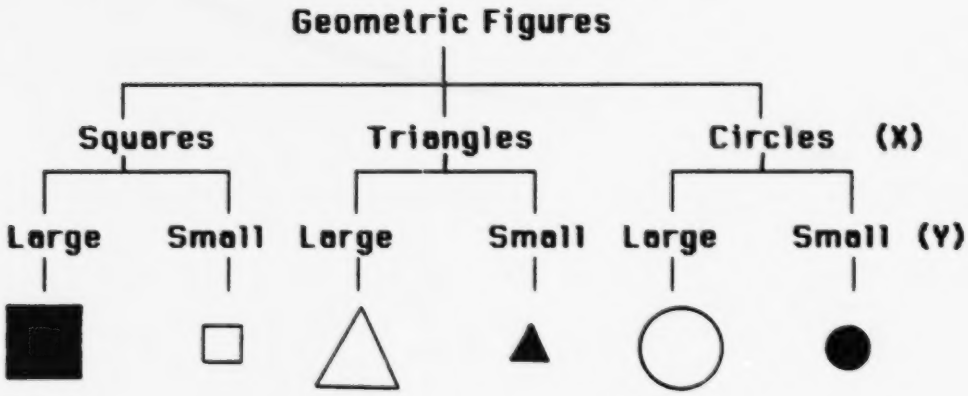
(a) by operation analysis (part to operation)
(b) by classification (species to genus)
(c) by structure analysis (part to whole)

16. Which object (a, b, or c) belongs in the same class with the two at left?

17. Which object (a, b, or c) belongs with the two at left?

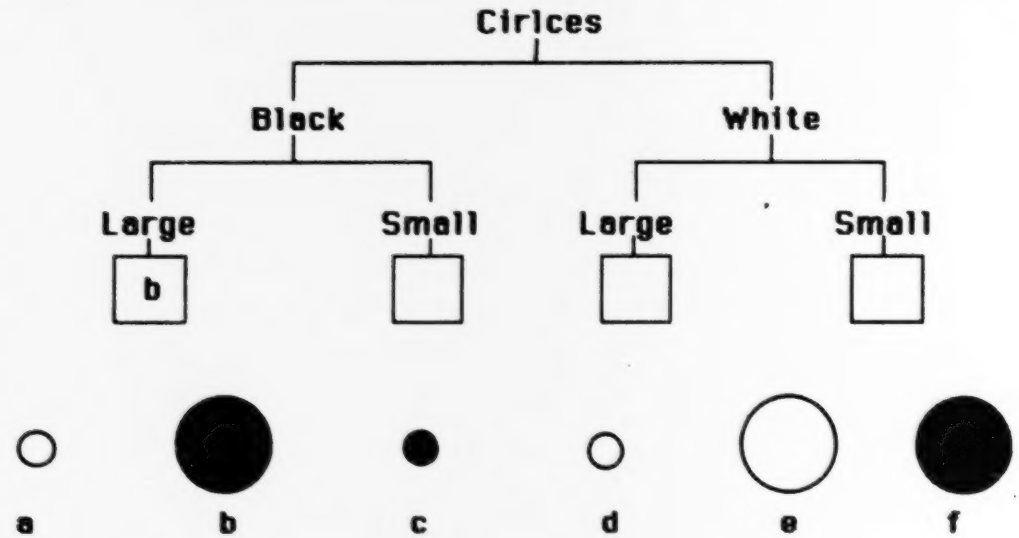


18. All things (whether people, automobiles, or mollusks) can be classified according to sorting factors--named qualities. Can you name the qualities by which things are sorted into classes, or types? In the diagram below, what is the sorting factor at X? At Y? What quality is ignored?



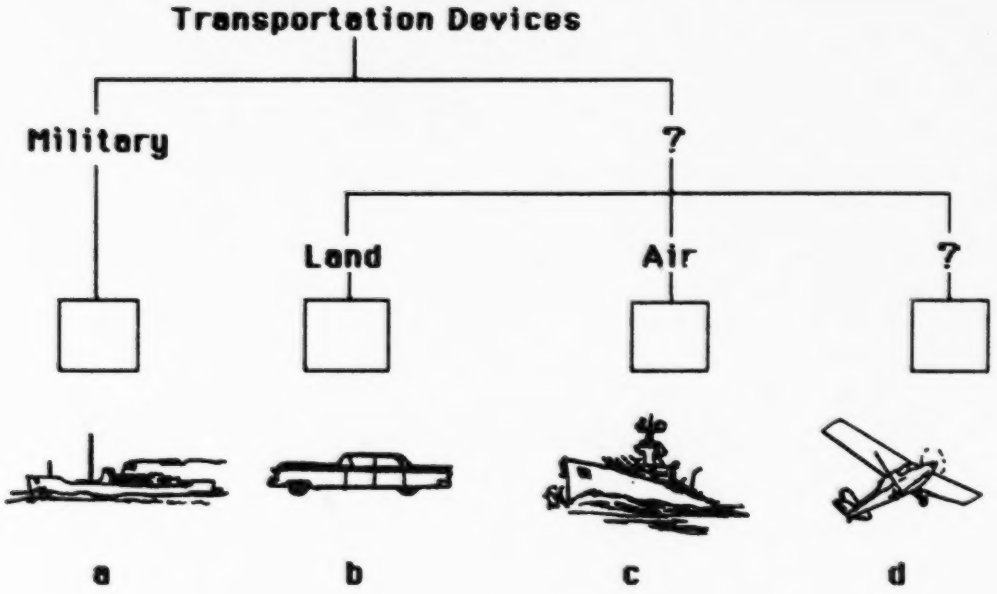
19. Which object (a, b, or c) belongs in the same class with the two at left?

20. Which circles go in which boxes? One circle has already been correctly pigeonholed.

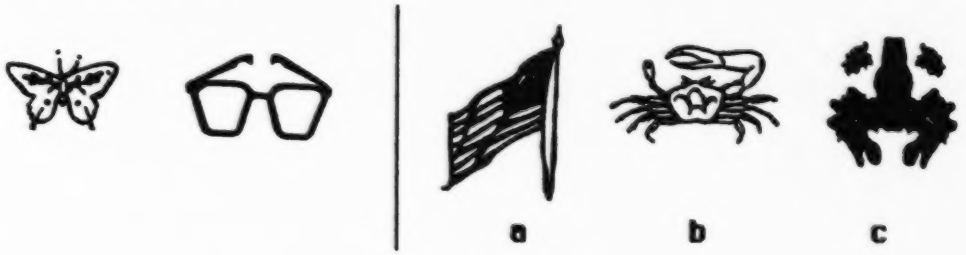


21. Pick the drawing (a, b, or c) which is most similar to the two at left.

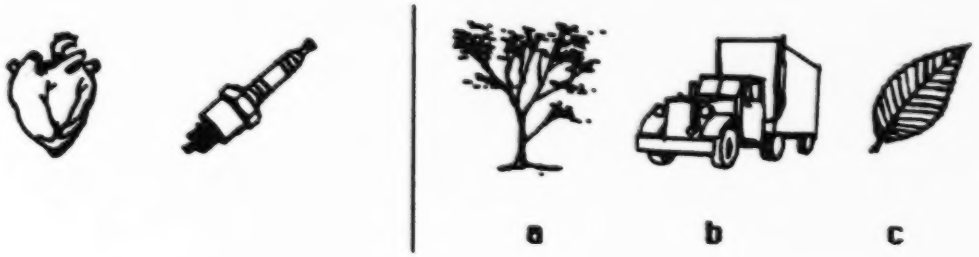
22. Which pictures go in which boxes? Can you think of adequate words to replace the question marks?



23. Which object (a, b, or c) goes in the same class with the two at left?



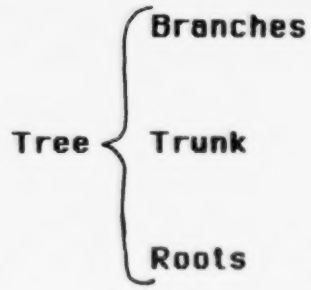
24. Which object (a, b, or c) belongs with the two at left?



25. Which item (a, b, or c) belongs in the same class with the two at left?

Human beings
Adults
Men
Women
Children
Boys
Girls

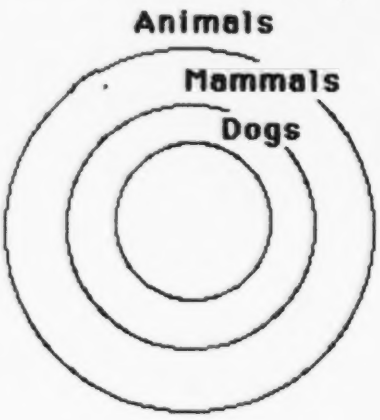
Books
Fiction
Non-fiction



a

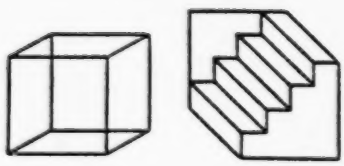
Life
Childhood
Adolescence
Adulthood

b



c

26. Which sentence (a, b, or c) belongs with the two drawings at left? Why?



a. No man hath seen God at any time.

b. The Lord is my shepherd.

c. In the beginning, God created the heaven and the earth.

Name _____ Date _____

Grade _____ Score _____

OPERATION ANALYSIS

1. Pick the answer (a, b, or c) which goes in the blank space of the sequence.

121212ABABAB1212 _____ BAB	12ABC	12ABA	ABABA
	a	b	c

2. Which answer (a, b, or c) goes in the blank space? Try dividing the sequence into "stages," treating it as if it were an operation.

ABACAABACAABACAABA _____	AB	CA	CB
	a	b	c

3. Which answer (a, b, or c) belongs in the blank space of the sequence?

AAaaBBb _____ Ccc	bB	cC	bC
	a	b	c

4. Town X is east of town Y. Town Y is east of town Z. Tom, who lives in town X, has two girl friends: Mary, who lives in town Z, and Nancy, who lives in town Y. Which is Tom likely to visit more often?

Mary

Nancy

5. Which word (a, b, c, or d) belongs in the blank space of the series?

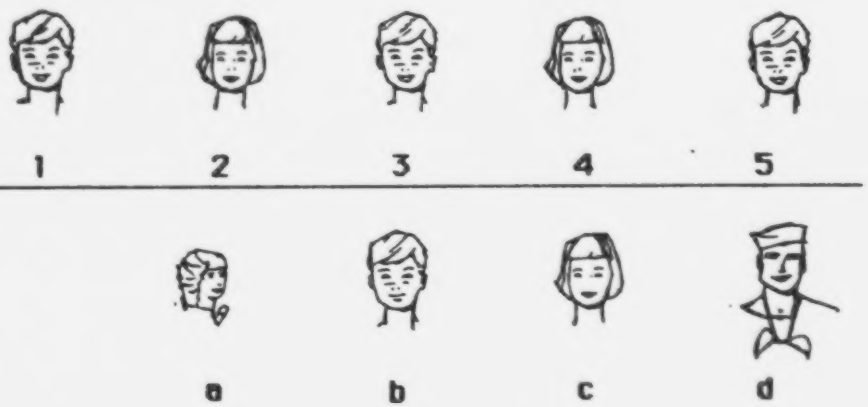
SECOND, MINUTE, HOUR, DAY, _____, MONTH

WEEK	YEAR	SATURDAY	NIGHT
a	b	c	d

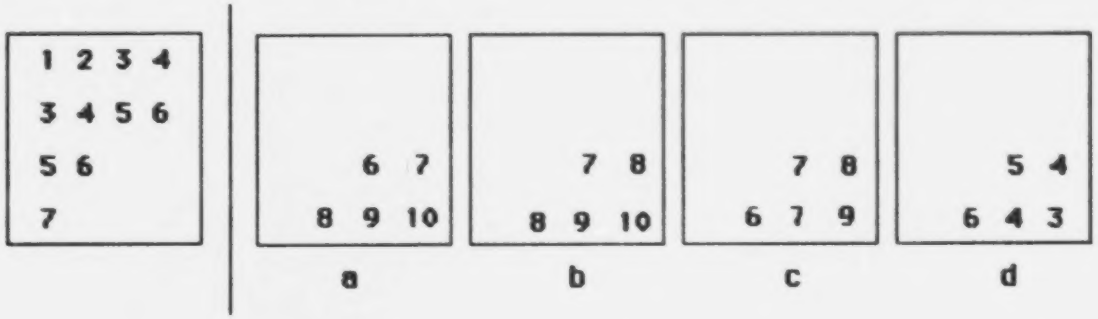
6. What number comes next in the sequence?

19, 17, 15, 13, 11, 9, 7, _____

7. Which drawing (a, b, c, or d) comes next in the sequence?



8. Which answer (a, b, c, or d) completes the box at left?



9. Which set of letters (a, b, or c) belongs in the blank space of the series?

123454321ABCD_____BA

EDC	C	EC
a	b	c

10. Which answer choice (a, b, c, or d) comes next in the series? Try dividing the sequence into stages, as if it were an operation.

XOXOXOXXOXOOXOXOXXXOXOXOXXXOXOXO
XXOXOOXOXOXXXOXOXOXXXOXOXOXXXOXOO
XOXOXXXOXOXOXXXOXOX_____

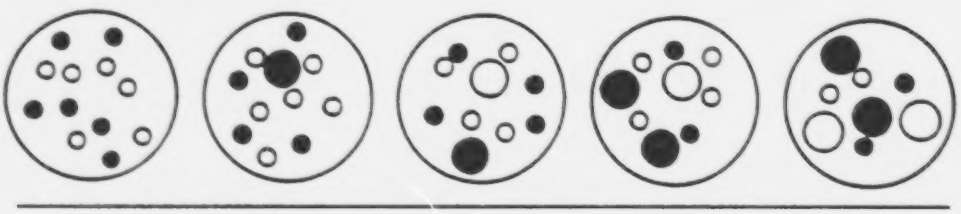
XOOXO	XOXOX	XXOXX	OXXOX
a	b	c	d

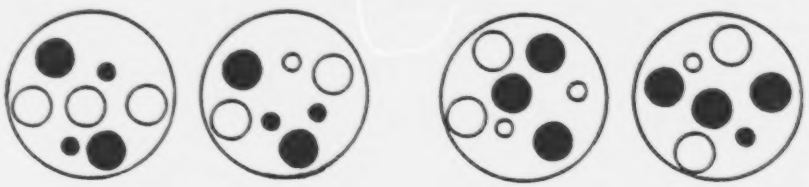
11. Which number (a, b, or c) comes next in the series?

1, 2, 4, 7, 8, 10, 13, 14, 16, 19, 20 _____

22	21	23
a	b	c

12. Which answer (a, b, c, or d) continues the sequence?





a b c d

13. White squares eat more than white circles. Black squares eat more than white squares. Black squares eat less than black circles. Which would make the most economical pet? Circle your answer.

Rover

Minerva

Pogo

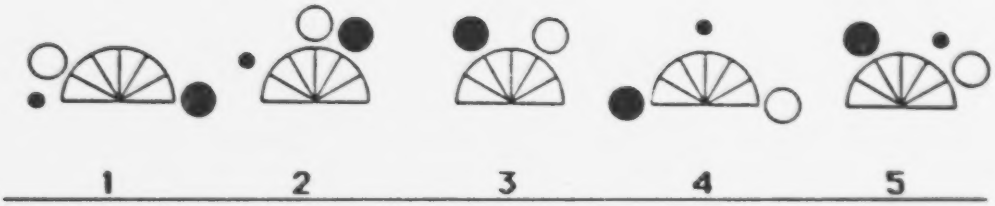
Snoopy

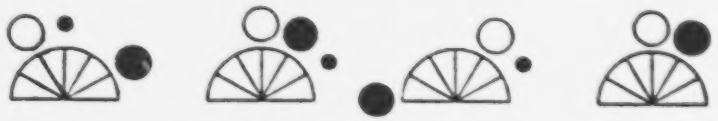
14. Which answer (a, b, or c) comes next in the sequence?

XOXOXXOXXOXOXOXXOXXOXOXOXXO_____

XOX a　　XXO b　　OXO c

15. Which answer (a, b, c, or d) comes next in the sequence?



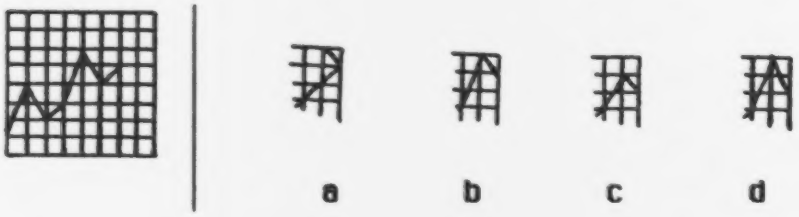


16. Which word (a, b, c, or d) comes next in the series? Why?

GUERNSEY, COW, MAMMAL, VERTEBRATE, _____

MARSUPIAL	CALF	ORGANISM	ANIMAL
a	b	c	d

17. If the present sequence continues, what will the remainder of the graph look like?

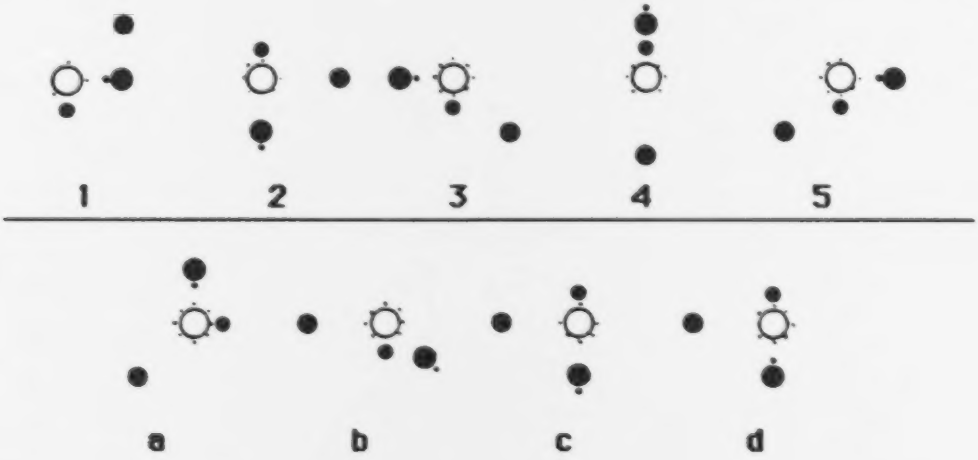


18. Which answer (a, b, c, or d) belongs in the blank space of the series?

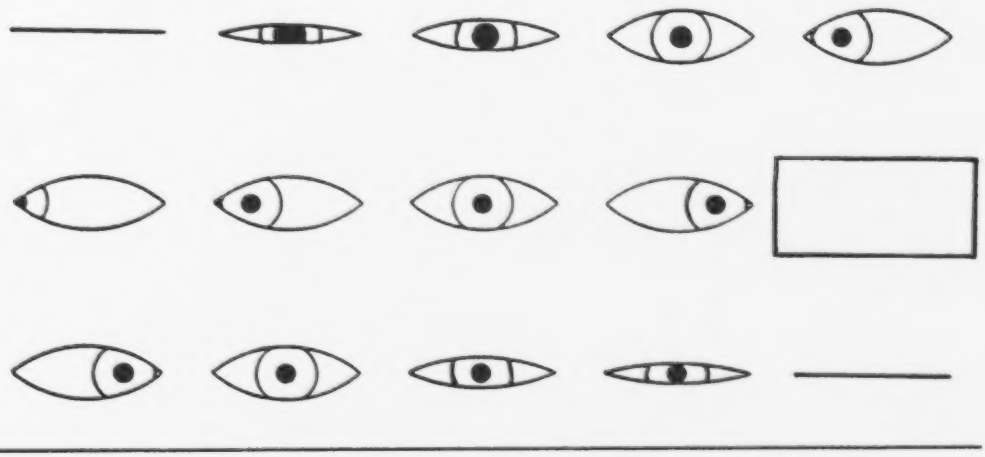
XX1X5XX2XXX4X3XXX3X_____X2XXXX5XX1XXX

X5X	4XX	XXX	XX6
a	b	c	d

19. Which drawing (a, b, c, or d) comes next in the sequence?



20. Which answer (a, b, c, or d) goes in the blank space of the sequence?



a b c d

21. Which answer (a, b, c, or d) continues the sequence?

L03,501-33C; L05,504-99999;

L12,509-2389HM98904B; L02,521-21; L06,523-54987K;

L19,529-47H39124577732257B9 _____

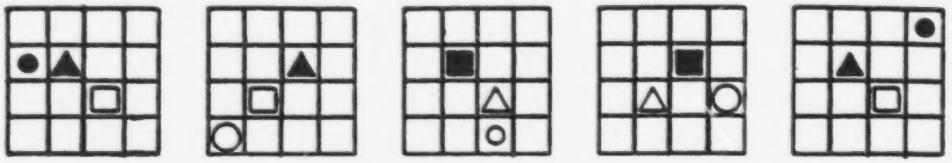
L07,536-046375N
a

L07,548-923847E
c

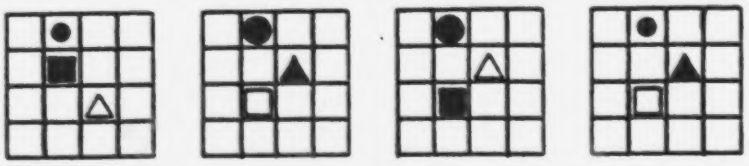
L08,548-5848372
b

L20,520-HALT
d

22. Which drawing (a, b, c, or d) comes next in the series?

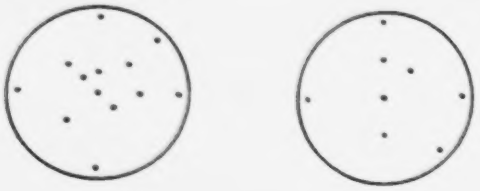


1 2 3 4 5

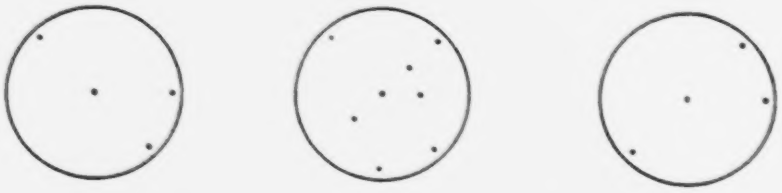


a b c d

23. Which answer (a, b, or c) continues the series?



1 2



a b c

Name _____ Date _____

Grade _____ Score _____

SEEING ANALOGIES

1. Which item (a, b, or c) belongs in the blank space?

SWEET _____ = _____

SOUR
a

b

YELLOW
c

2. Which drawing (a, b, or c) belongs in the blank space?

_____ = _____

a

b

c

3. Pick the answer (a, b, or c) which belongs in the blank space.

_____ = _____

a

b

c

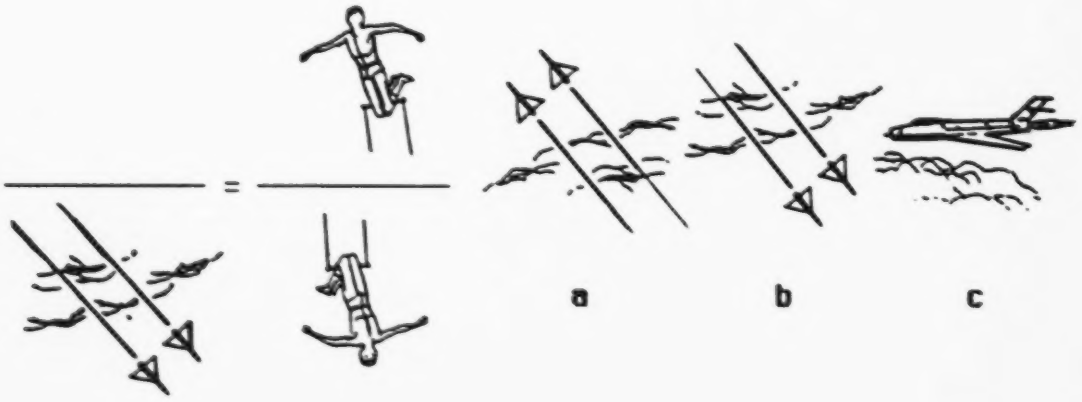
4. Pick the word (a, b, or c) which completes the analogy.

RENT / MONTH = GASOLINE / ____	GALLON	VOLUME	VOLATILE
	a	b	c

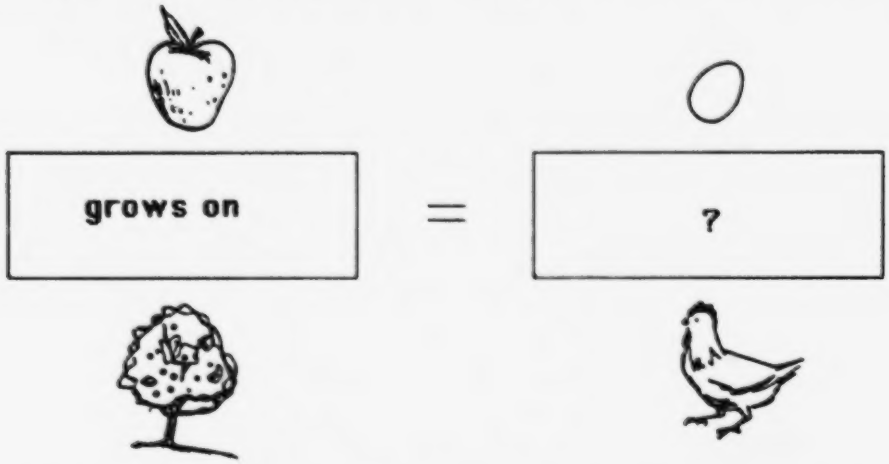
5. Which word (a, b, or c) completes the analogy?

COIN / DIME = ____ / DOLLAR	QUARTER	MONEY	BILL
	a	b	c

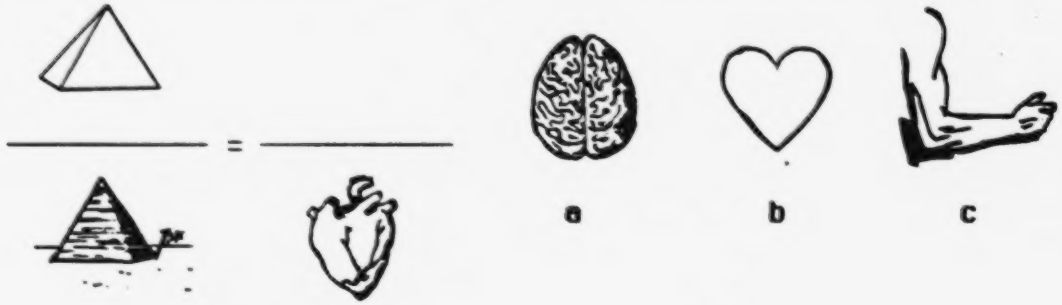
6. Pick the drawing (a, b, or c) which best completes the analogy.



7. Can you make up a phrase to replace the question mark?



8. Which drawing (a, b, or c) completes the analogy?



9. Which word (a, b, or c) completes the analogy?

HOUR / DAY = HORSES / ____

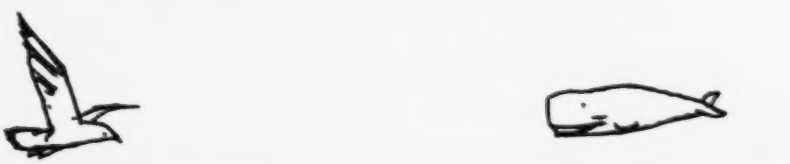
MARES (a) ANIMALS (b) CARNIVORES (c)

10. Which item (a, b, or c) completes the analogy? Why?

11. Which answer (a, b, or c) completes the analogy?

a b c

12. Can you make up two different phrases to replace the two question marks?



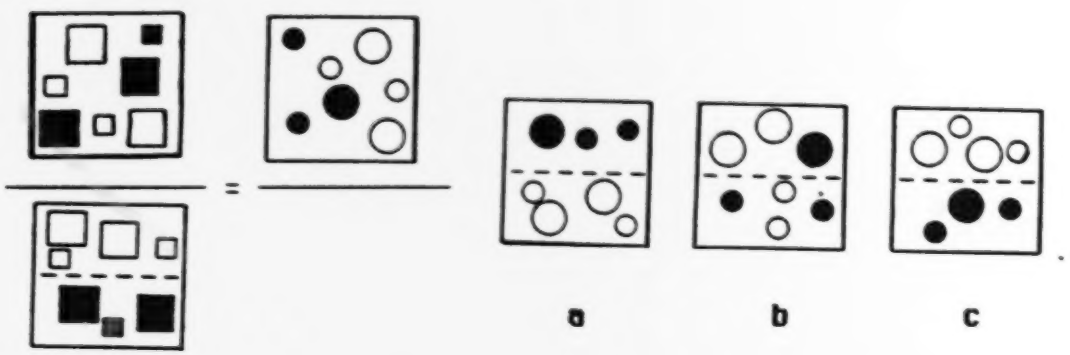
SKY SEA

13. Pick the answer (a, b, or c) which best completes the analogy.

ELECTRON / ATOM = PLANET	EARTH	SUN	SOLAR SYSTEM
	a	b	c

14. Which drawing (a, b, or c) goes in the blank space?

15. Which square (a, b, or c) goes in the blank space of the analogy?



16. Which answer (a, b, or c) best completes the quotation?

"I do not know what I may appear to the world, but to myself I seem to have been only a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or prettier sea shell than ordinary, _____"

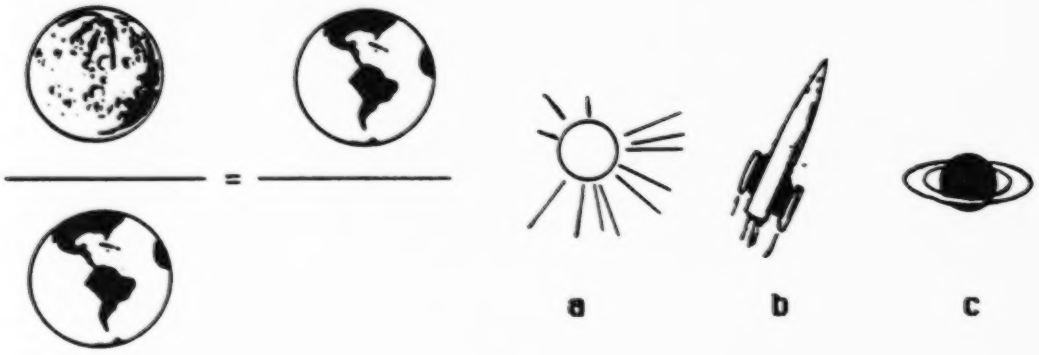
Brewster's Memoirs of Newton

(a) Whilst the great wave of Einstein's theory prepared to engulf my petty discoveries.

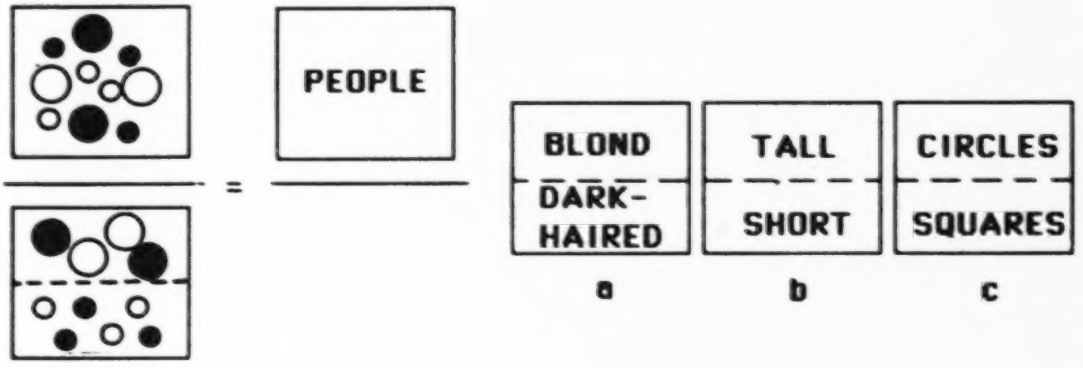
(b) Whilst the great ocean of truth lay all undiscovered before me.

(c) Whilst the bigger boys discovered boulders of infinite truth.

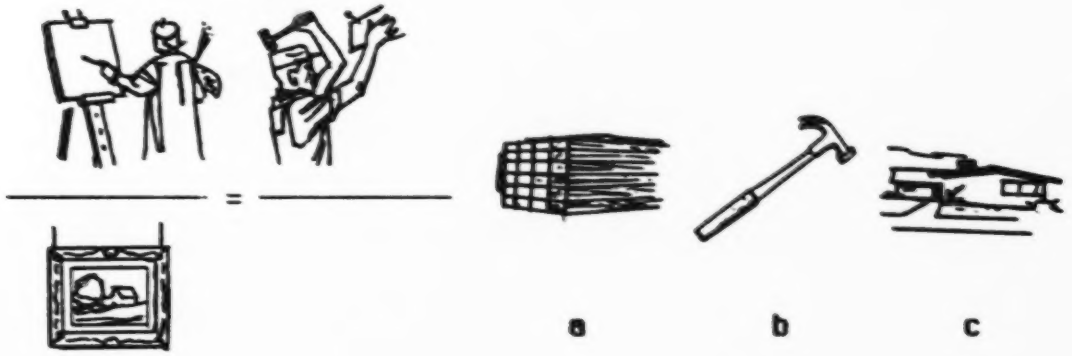
17. Which item (a, b, or c) goes in the blank space of the analogy?



18. Which item (a, b, or c) completes the analogy?

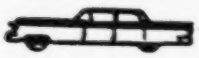


19. Pick the drawing (a, b, or c) which best completes the analogy.



20. Choose the object (a, b, or c) which completes the analogy.

_____ = _____

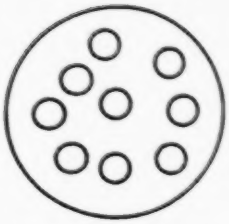


a

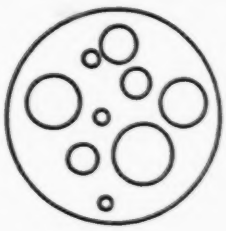
b

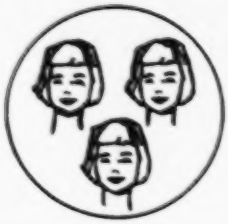
c

21. Which item (a, b, or c) completes the analogy?



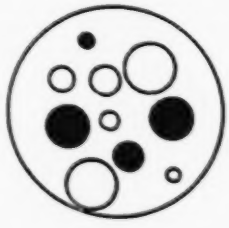
_____ = _____





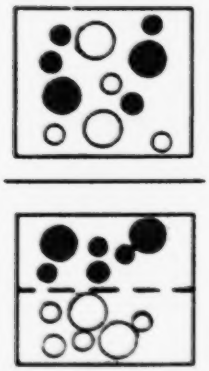
a

b



c

22. Which item (a, b, or c) completes the analogy?



PEOPLE

=

SHORT	ORANGE	DARK-HAIRED
TALL	APPLES	BLOND
a	b	c

23. Which word completes the analogy?

BIRTH / LIFE = DAY

MORNING	WEEK	SUNRISE
a	b	c

24. Which answer (a, b, or c) completes the analogy? Why?

RED / NEERG =

a b c

25. Which word (a, b, or c) completes the analogy?

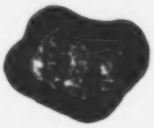
= MORNING

DAY	EVENING	NIGHT
a	b	c

26. Which drawing (a, b, or c) completes the analogy?

TITIKAKA _____ = ORANA _____

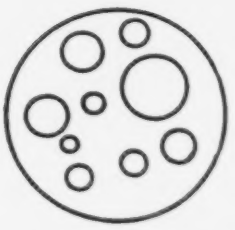
a



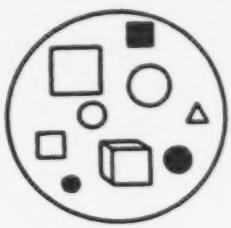
b

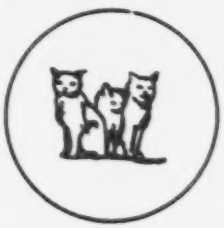
c

27. Which answer (a, b, or c) best completes the analogy?



_____ = _____





a

b

c

Name _____ Date _____

Grade _____ Score _____

STRUCTURE ANALYSIS

1. Which line (a, b, or c) best completes the poem? Why?

One, two, three
What do you see?
Four, five, six
_____

a. Tom Mix
b. The river Styx
c. Pipers three

2. Which words go in which spaces of the diagram?

Blade

Knife _____ { _____ / _____

Handle

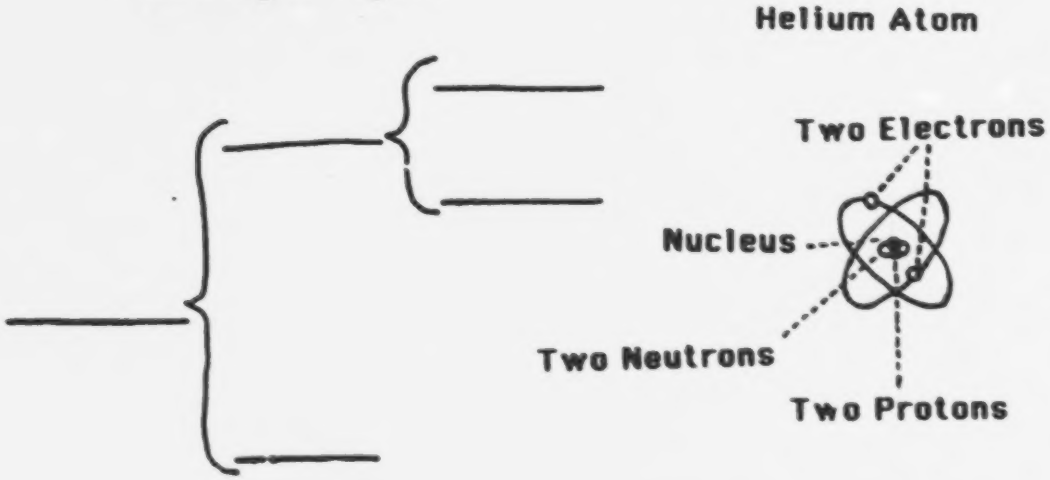
3. How does the meaning of <u>ocean</u> shift from the first sentence to the second?

The <u>ocean</u> covers more than two-thirds of Earth's surface.

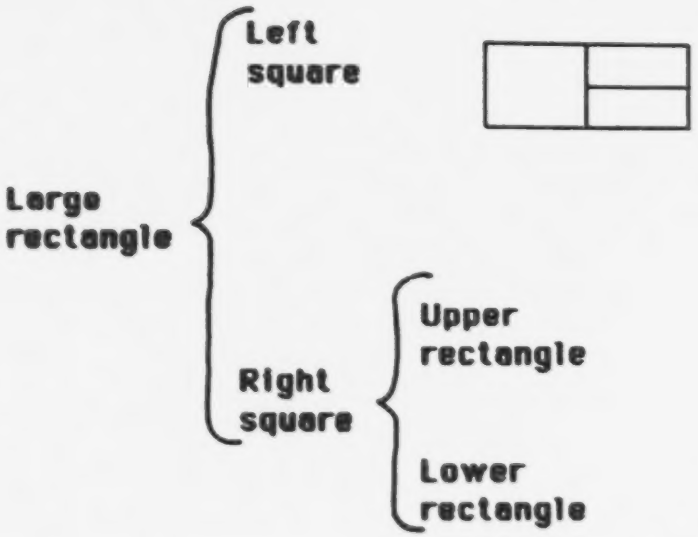
Which <u>ocean</u> is larger, the Atlantic or the Pacific?

(a) by operation analysis (stage to operation)
(b) by structure analysis (whole to part)
(c) by classification (genus to species)

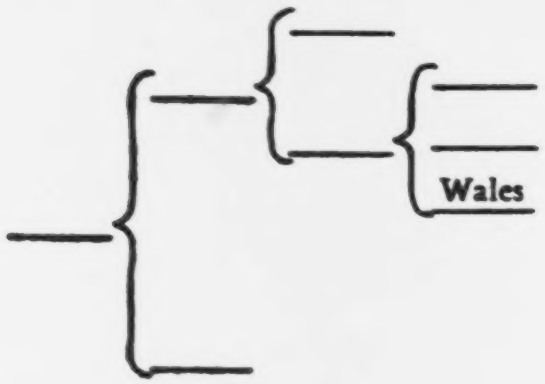
4. Which words go in which spaces of the structure analysis diagram? Take the words from the drawing at right.



5. Make a structure analysis diagram of the circle at right. Below is a sample structure analysis diagram of another figure. (Construct your diagram on the back of this page.)



6. Which words go in which spaces of the structure analysis diagram? Take the words from the map. One of the words has already been correctly placed.



7. **Make a structure analysis diagram of the map below. For example, if you were to analyze the structure of the solar system, you might make a diagram such as the one shown. (Construct your diagram on the back of this page.)**